

Yai, Koh Lanta; Province, Krabi

Working Paper

A master plan for sustainable tourism development

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Working Paper 2007-06



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**INSTITUTE OF URBAN AND
REGIONAL DEVELOPMENT**

A Master Plan for Sustainable Tourism Development

Koh Lanta Yai, Krabi Province

**Chulalongkorn University
University of California, Berkeley
Thai Public Policy Foundation**

July 2007

UNIVERSITY OF CALIFORNIA

WP-2007-06

***A Master Plan for Sustainable
Tourism Development***

Koh Lanta Yai, Krabi Province

Chulalongkorn University
University of California, Berkeley
Thai Public Policy Foundation
2007



Berkeley
UNIVERSITY OF CALIFORNIA



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Acknowledgments

Once again we have been privileged to participate in a remarkable international educational partnership between Chulalongkorn University, Bangkok and the University of California, Berkeley. Together, ten Chulalongkorn students and ten Berkeley students, with the participation of the community of the island of Koh Lanta Yai, created this document. It makes clear the options for the future development of the island as a home to local people and as a tourist destination. The balancing of livelihood and environment is global question, but it is answered in local decisions and local places. Our intent in this document is to make the choices attending the residents and leaders of Koh Lanta Yai evident, and to reshape the future of the island to continue to be a healthy, sustaining home to its residents, supported by carefully considered tourism.

This project is the second of three collaborative efforts focused on the Krabi Province of Thailand. Through the foresight and commitment of its President, Khun Chote Sophonpanich, the Thai Public Policy Foundation has provided the leadership and extraordinary support in these efforts, to mutual cross-cultural learning and environmental sustainability. We were fortunate that Khun Pissimai Khandobee, advisor to the Foundation, was an indefatigable participant and facilitator in all phases of the project and brought a deft touch to the many aspects of logistics, translation, and field research.

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Professor Siriwan Silapacharanan of the Department Urban and Regional Planning and Lecturer Pitch Pongsawat of the Department of Government, co-directed the studio. Without their effective, energetic, and insightful guidance, the project simply would not have been possible. The Chair of the Landscape Architecture Department, Professor Angsana Boonyob, has provided careful critiques of our work in Bangkok. Lecturer Danai Thaitakoo of the Department of Landscape Architecture was essential to the field research in Koh Lanta Yai and invaluable shared his profound understanding of the Thai environment with us.

We have been honored with such exceptional partners and we look forward with enthusiasm to future collaborations.

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Fishing boat in Mangrove Forest: traditional means of livelihood in Koh Lanta Yai.

Introduction

The Sumatra-Andaman Earthquake and Tsunami

On December 26, 2004, a massive undersea Sumatra-Andaman earthquake, measuring 9.3 on the Richter scale, jarred the waters of the Andaman Sea. Approximately 580 kilometers off the coast of Thailand, it caused a devastating tsunami wave 10 meters in height to strike the coast of 6 provinces of western Thailand, completely destroying 47 villages and severely impacting 360 other villages. As of May 2006, the death toll was 8,212 people, with approximately 500 bodies still unidentified, 2,817 people still missing, and 8,457 people seeking treatment for injuries. The tsunami also orphaned 1,637 children.

The economic impacts of the tsunami were immediate and widespread. The Tourism Authority of Thailand (TAT) estimates that tourist arrivals fell by 20% in Thailand, leading to a loss of \$25 million each month, resulting in the loss of 120,000 jobs

in the tourism sector. The TAT reports that the Andaman region alone suffered a 30% loss of tourist arrivals in the region.

Other sectors of the Thailand economy were similarly affected by the tsunami. Approximately 5,000 boats were lost or damaged, and 30,000 people lost their jobs in the fisheries sector. Over 2,000 hectares of agricultural land were destroyed. Overall, economic losses are estimated at \$1.6 billion, with repair costs estimated at \$482 million.

The tsunami severely affected fragile nearshore ecosystems in Thailand. Over 305 acres of mangrove forests were impacted. Over 3,600 acres of coral reefs were damaged. Approximately 400 acres of seagrass beds, vital for both habitat and grazing, were flooded. The intrusion of saltwater from the tsunami, in addition to damaging 2,000 hectares of agricultural land, also contaminated 102 large ponds, 2,321 wells, and two ground wells. (www.tsunamispecialenvoy.org/country/thailand.asp)

The Partnership: Chulalongkorn University, the University of California, Berkeley, and the Thai Public Policy Foundation

In February 2005, in response to the severe economic and environmental damage caused by the tsunami, Chote Soponpanich, President of the Thai Public Policy Foundation, contacted Robert Birgenau, Chancellor of the University of California at Berkeley, to explore a possible collaboration between the institutions in post-tsunami planning for sustainable tourism development. A partnership was formed between the 3 institutions, leveraging prior institutional connections with the Chulalongkorn University's Social Research Institute in Bangkok.

Workshop 2005

From May to October 2005 the partnership developed its first project — *Strategic Plan for Sustainable Tourism Development in Krabi Province*. With support from the Thai Public Policy Foundation, a workshop comprising 10 graduate students from University of California, Berkeley and 10 graduate students from Chulalongkorn University with backgrounds in city planning, architecture, government, political science, and sociology conducted field research throughout Krabi Province. To identify advantages and disadvantages of various planning policies, the workshop developed three local tourism development scenarios, cross-matrixed with three global economic prosperity scenarios. Utilizing an extensive community participation process, the plan concluded that sustainable tourism development must take place within the context of integrated regional planning for environmental health of forests and watersheds, efficient provision of infrastructure, and equitable and self-sufficient economic and social development.

The government of Krabi province, recognizing the importance of tourism industry development for the overall recovery of the Andaman region, began to prioritize tourism "hubs" for the Andaman region. The tsunami damaged the infrastructure of

a popular "eco-tourist" destination, the Ko Phi Phi islands, beyond the capabilities of near-term repair, especially since the islands are located within a marine sanctuary. Therefore, the government identified Koh Lanta Yai for tourism development as the next Hub of the Andaman, since its existing infrastructure was not extensively damaged by the tsunami.

Workshop 2006

A new workshop to develop the Master Plan for Sustainable Tourism Development in Koh Lanta Yai in May to June 2006 was the natural continuation of the 2005 workshop in Krabi Province. It was comprised of ten graduate students from University of California, Berkeley and ten graduate students from Chulalongkorn University, Bangkok, with backgrounds in city planning, architecture, political science, landscape architecture, civil and environmental engineering, industrial engineering and operations research, and human and social development. Together they conducted field research in Koh Lanta Yai and returned to Chulalongkorn University, Bangkok for additional expert debriefings, extensive data analysis, and a series of daily design charrettes. Initial findings and proposals were presented at Chulalongkorn University on 16 June 2006. In July and August 2006, the Chulalongkorn students returned to Koh Lanta Yai to conduct further field research. In September 2006, the students from both universities re-convened at their respective universities to analyze the findings from the field research, and prepare a presentation for the local community members and government officials in October 2006. The findings, analysis, and recommendations of the field research and workshop comprise the content of this report.

Working Objectives

The workshop began with four working objectives:

1. Environmental protection of key ecological resources including mangrove forest, coral reef, fisheries, and wildlife

2. Respect for the social and cultural heritage of the island residents
3. Development of tourism to integrate local people
4. Integration of local knowledge and initiative in the master planning process

Working Groups: Ecology, Infrastructure, Economic-Social-Cultural-Political

In the master planning process, the graduate students from Chulalongkorn University and the University of California, Berkeley initially met in Bangkok for a series of expert debriefings, and then formulated a plan to assess the conditions of the island. The students arranged themselves into three groups to conduct the field research and analysis:

- Ecology
- Infrastructure
- Economic-Social-Cultural-Political

Each group conducted field research within their focus area, to the extent possible all groups visited interview sites and candidates at different times and dates to form a comprehensive and multi-disciplinary analysis of the entire island community. The workshop re-convened each evening to allow each group to present its findings to the other groups, and formulate a strategy for the next day's field research. After eight days of field research, the workshop re-convened daily in Bangkok for an intensive brain-storming and charrette, in preparation for a preliminary presentation of recommendations at the conclusion of the summer workshop session.

Ecology

The primary focus of the Ecology group was to assess the current ecosystem health of the island and determine best management practices to sustain local ecology as part of a tourism development strategy. They identified the island ecosystems and

their primary threats. The group approached the island's ecological assessment from a watershed perspective, determining that watersheds are the "veins" of the island, providing the link between island activity and ecological health. Using Geographic Information Science (GIS) analysis, the group identified the island's watersheds and their level of development. The groups examined three watersheds closely that typified watersheds that were 1) heavily-developed, (2) medium-developed, and (3) minimally-developed to determine the source and effects of local and tourist activity occurring within each watershed. The comparative control was a watershed consisting mainly of undeveloped rainforest.

Infrastructure

The Infrastructure group focused on assessing four areas of the island's infrastructure: roads, transportation (including the ferry connection and proposed bridge), water resources, and solid waste management. The roads and transportation systems were evaluated for their effectiveness for local and tourist mobility, and their effects on the island's ecosystems. Water resources, which vary considerably on the island, were evaluated in terms of quantity, quality, equity of access, and as a long-term resource. Solid waste management, and obvious issue on the island, was examined regarding it's relation to quantity, collection, fees, the existing dump, and ecological and aesthetic effect. The group also investigated existing examples of sustainable infrastructure on Koh Lanta Yai.

Economic-Social-Cultural-Political (ESCP)

The goal of the Economic-Social-Cultural-Political (ESCP) group was to determine the interconnection between the island's local residents and the role of tourism in their daily lives. The group conducted over 120 interviews with island locals, in group and individual settings, and in formal town hall settings as well as in local residents' homes. The previous year's workshop revealed that a government-led tourism strategy has neither addressed the complex needs of Koh Lanta Yai Yai communities

nor strengthened them in the face of international tourism. The ESCP group examined how local culture and practices, tourism development, and the local governance interact, guide, and sustain the island's future in the face of expected tourism growth.

The Master Plan

The vision of the master plan for Koh Lanta Yai is that the island holds value not only as an ideal tourist destination but also as a home – Lanta Ban Rao. The island faces numerous risks associated with unconstrained development; its ecosystems are rapidly deteriorating in quality, and better management practices must be implemented immediately to protect the island's resources, not just as a hub of tourism in the Andaman Sea, but also as a home for the current local residents and future Thai generations.

The following chapters of this report outline the role of Koh Lanta Yai as a tourist destination and home, the island's development risks, its ecological resources and threats, its cultural resources and threats, and several immediate recommendations that need to be implemented to preserve these ecological and cultural resources. The key development recommendations are encompassed by the vision of Lanta Ban Rao, which unites and balances the needs and ambitions of the local residents, the tourism industry, and the government agencies into a single sustainable tourism development strategy. A key component of Lanta Ban Rao vision is a cluster development strategy to maximize the unique tourist-attracting qualities of the island, minimize the impact of tourism on the ecological resources that attract tourism, and promote efficient development and delivery of government infrastructure services. A second key component of the Lanta Ban Rao vision is the formation of a community-led organization that provides a forum for local residents, tourism industry partners, and government agencies to participate and collaborate in the sustainable tourism development of Koh Lanta Yai Yai.

As with any master planning study, there are several limitations to this study. Much of the field work and research was conducted during the low tourist season, minimizing the ability to observe first hand the full impact of tourism on the islands resources. However, the extensive interviews conducted with island locals and observation of the threats to the ecosystem during the low season provide a view of this impact, while also revealing the hardships endured and the local wisdom practiced by the local residents when the tourism economy abates.

This master plan does not focus on maximizing tourism development or growth. Instead, the master plan is a study of better management practices to promote a sustainable tourism strategy for the island with a focus on preservation of the environmental, social and cultural assets of the island necessary for the high-value tourism preferred by both tourists and local residents. Primary attention is given to the development of infrastructure to satisfy the basic needs of the island's local residents, with the belief that a grassroots approach will empower the locals to maximize the island's tourism potential with awareness of the connections between their environmental and socio-cultural assets.

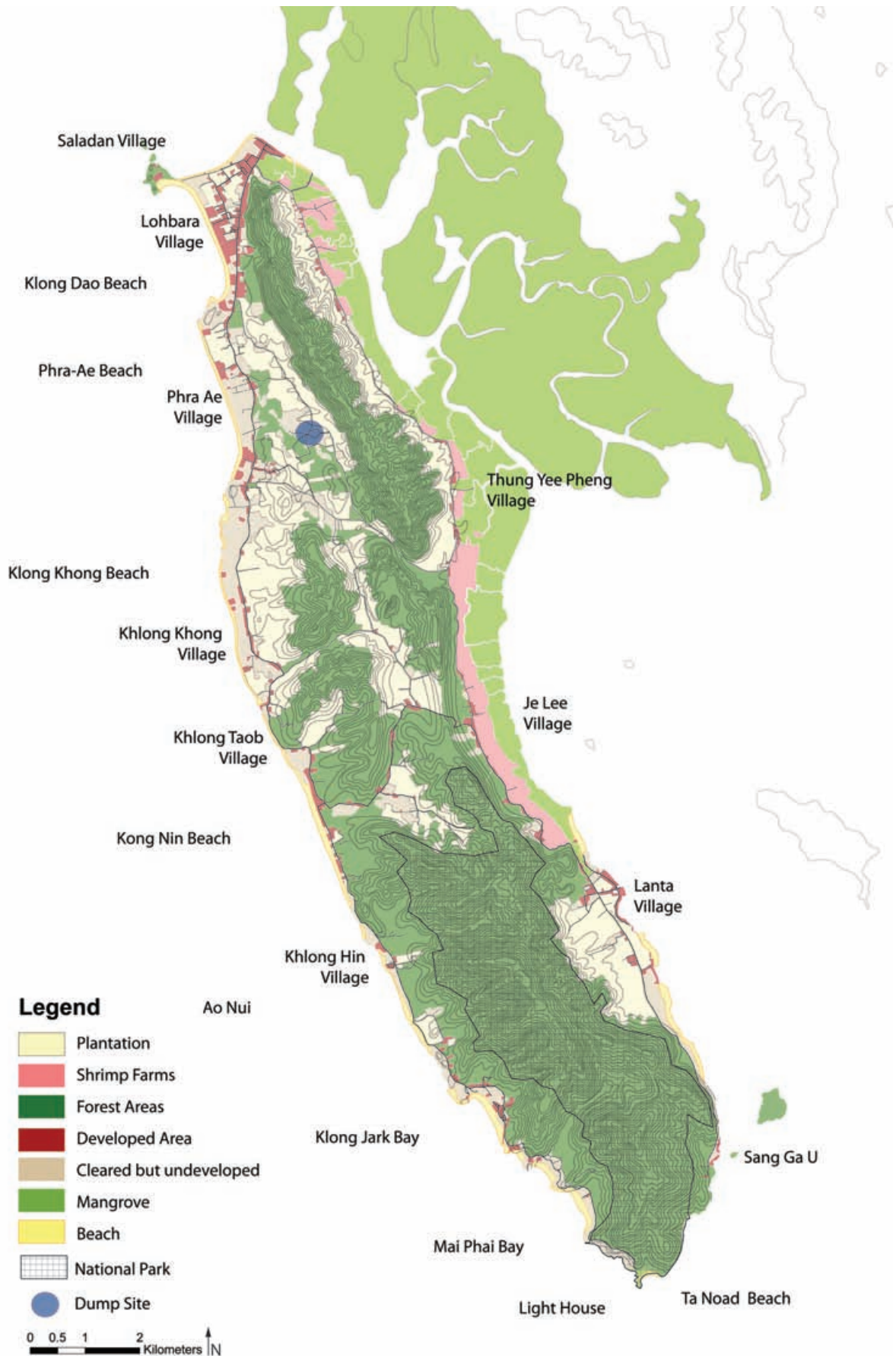
Koh Lanta Yai – Tourist Destination and Home

Location, Population, Tourism Figures

Koh Lanta Yai is an island located in the southern Thailand province of Krabi. It is approximately a twelve hour drive from Bangkok, a two hour drive from Krabi airport, or accessible via seasonal ferries from Koh Phi Phi or Krabi Town. Koh Lanta Yai has a permanent population of 9,245 and a seasonal population of 4,874. The population is 90% Muslim.

Koh Lanta Yai has been experiencing a boom in tourism in the past five years. The number of resorts and hotels has tripled from 46 in 2001 to 154 in 2006. The increase in the number of hotels is consistent with the increase in the number of

Figure 1. Current Land Uses



overnight tourists. In 2001 there were 113,000 overnight tourists, while in 2004 there were 210,000. Despite the rise in overnight tourists, the tourist season is still highly seasonal, and current annual occupancy rates are only about 50%. Tourism marketing for the island has also increased, and Koh Lanta Yai is increasingly promoted in brochures, guidebooks, and on the Internet.

Current Land Uses

Current land uses for Koh Lanta Yai are diverse, ranging from highly developed resort areas to pristine rainforests. These uses include plantations, shrimp farms, forest areas, cleared but undeveloped areas, mangroves, beaches, national park area, a dump site, and developed areas for local and tourist use, as shown in Figure 1.

Plantations are scattered throughout the island, though they are most heavily concentrated in the northwest part of the island. Rubber plantations are the most common types of plantation, though a few banana and oil palm plantations also exist. With rising rubber prices, the number and area of rubber plantations will likely increase in the near future.

Shrimp farms are located mostly on the eastern side of the island, in areas just upland from mangrove forests. They must be located near the ocean because they continuously pump ocean water through the ponds. Shrimp farms have a very limited lifespan because of the chemicals that are involved in this process. Shrimp food contains high levels of nitrogen and antibiotics, the majority of which are excess and not used by the shrimp. The excess quantities either form sediment at the bottom of the pond or are flushed out to the sea as effluent. Because of this process, the soil of the shrimp farm will soon become toxic to the shrimp. The maximum lifespan of a shrimp farm on Koh Lanta Yai is approximately 5 years. After toxic saturation, the land is either filled and used for banana plantations or simply abandoned. Examples of each of these types of management is evident on the eastern side of the island. Though

shrimp farming has detrimental environmental consequences, Koh Lanta Yai exports significant quantities of shrimp, and shrimp farms are unlikely to diminish as long as they are profitable in the short-term.

Forest areas are located upland, generally in areas that are too steep or too remote for farming. Forest areas are at the head of many island watersheds, helping to infiltrate and purify water before it flows down one of Koh Lanta Yai's many streams. Forested areas also minimize erosion, provide habitat for native species, reduce the temperature on the island, create shade, produce oxygen, and are attractive from a tourism standpoint. The majority of the privately owned forested area has been cleared for rubber plantations or development and, consequently, much of the remaining forested area is within the boundary of the National Park located on the southern sector of the island. The amount of forested area has been halved since 1985, and the national park boundary seems to be the only mechanism to prevent wholesale destruction of the remainder.

Koh Lanta Yai's land use is changing quickly, and many pieces of land are cleared but undeveloped. The future of this land is unclear. Perhaps it was logged for valuable timber, or perhaps it was cleared for development that did not occur. Land of this type is located throughout the island, and often on the fringe of current developments. In many cases, even though the land was cleared, unmanaged vegetation is now beginning to overgrow the area.

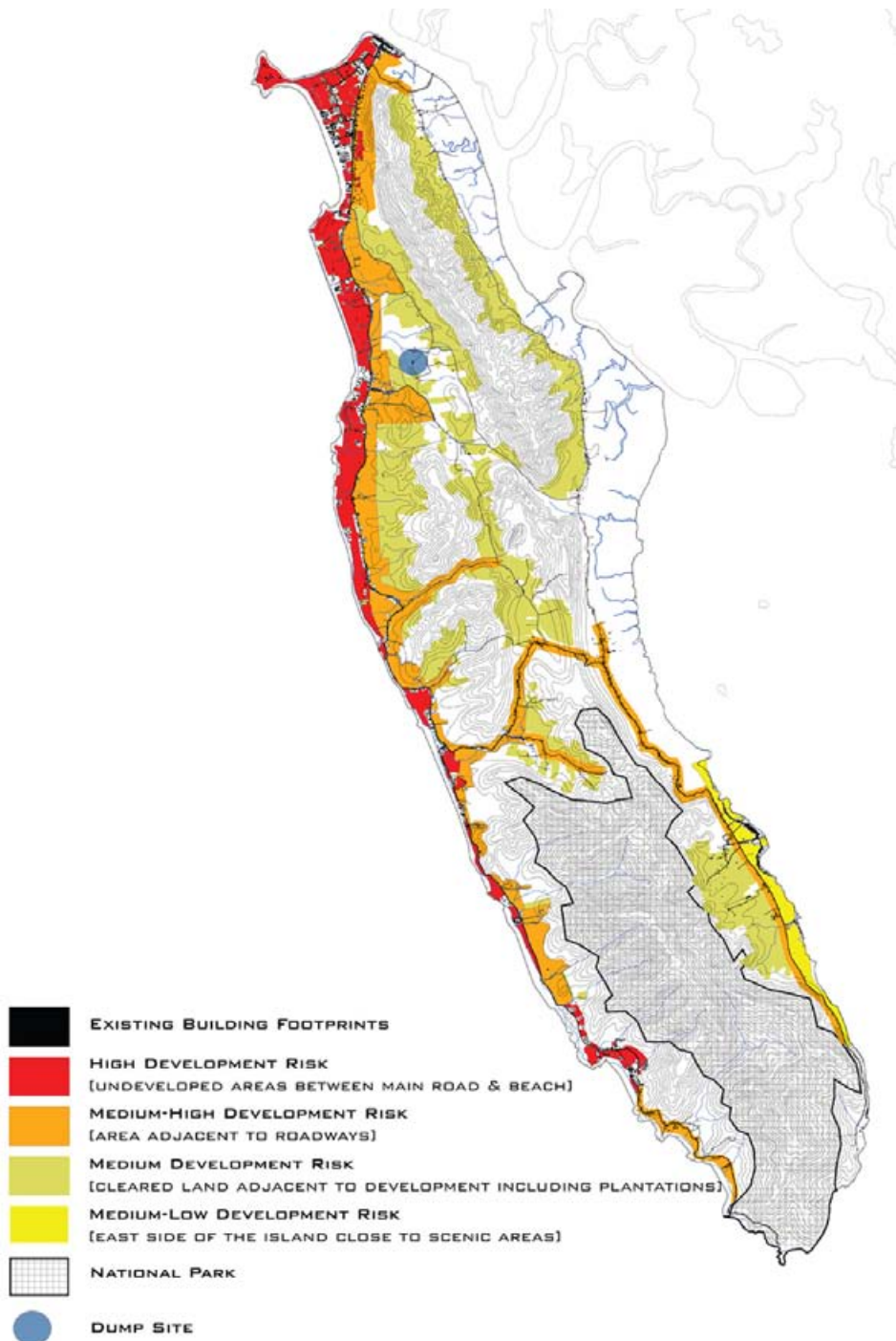
Mangroves are found in the northeast part of the island, as well as on the southwest part of Koh Lanta Noi. These areas together form a rich and extensive mangrove forest. The importance of the mangrove forests is paramount. These unassuming areas are hatcheries for large populations of fishes and crabs, habitat for birds, act as sediment traps for streams and rivers, and act as a buffer for coastal erosion. Mangroves are crucial to supporting coastal fisheries. We saw evidence of protection

and replanting of some destroyed mangrove area in the northeast part of the island, but mangrove forest is still being destroyed for firewood or to allow room for transient housing of the Thai-Mai people.

The beaches of Koh Lanta Yai are one of its largest tourist draws. Nearly all these beaches are located

on the west side of the island. The quality of the beaches varies seasonally. During the rainy season, winds from the southeast bring debris, jellyfish, and sediment to the beaches, making the beaches unattractive. During the dry season, winds blow from the northeast, making water calmer, the beaches cleaner, larger, and more attractive. Koh Lanta Yai's beaches are not pristine, white sand

Figure 2. Future Development Risks



beaches but are a draw to the tourists visiting the island.

The National Park on Koh Lanta Yai is located in the south. It has several miles of coastline, but is mostly upland old-growth forest. The national park is accessible via a road along the western coast of the island which is currently being improved to facilitate access. The national park lacks the resources or power to enforce its boundaries, and they may not be well marked or understood—timber poaching and building is not uncommon.

The island's dump site is located in the northern portion of the island, above Phra Ae village. It is currently the only trash collection dump on the island. It is expanding rapidly, but without any mechanism to control or plan for growth.

Development Trends

Developed areas on the island are scattered along the coast. Most tourist facilities are located on the west coast, in close proximity to the island's best beaches. The character of tourist areas and local areas is significantly different. A glance at Koh Lanta Yai reveals a drastic discordance between scale and design of facilities for tourists versus those used by the local population.

In Lanta Village and the Old Town, the scale and design of the commercial corridor is small and

modest, with storefronts that open to the street. Private residences surrounding the villages are small, free standing structures offset slightly from the street, many with a covered porch area. There is no obvious use of fences or gates around residences or commercial properties. Doors open to the street. In villages, there is ample shared open space that is clearly integrated into the built fabric.

Hotel and bungalow resort facilities, in general, are not located within Koh Lanta Yai's villages. They occupy large parcels of land, usually with direct access to the beach. Long paved and unpaved driveways provide access to these resorts from the main road. Some have controlled access gates, drives, and security personnel. The newer resorts along the southwest coast are larger in scale and their design does not even minimally reflect the local style. In general, the sheer variety of building types and visual dominance of resort facilities makes it unclear what the local aesthetic on the island is. The resorts are characterized by quick development, extensive concrete use, poor site planning, and a focus on short-term growth. Compounding this problem, older residences along the main road are juxtaposed next to the entrances and gates of large resort complexes, creating a visual disparity that emphasizes the divergent standard of life experienced by locals and visitors. Koh Lanta Yai is developing quickly, and it faces many of the same risks that any rapid growth

Figure 3. Existing Development

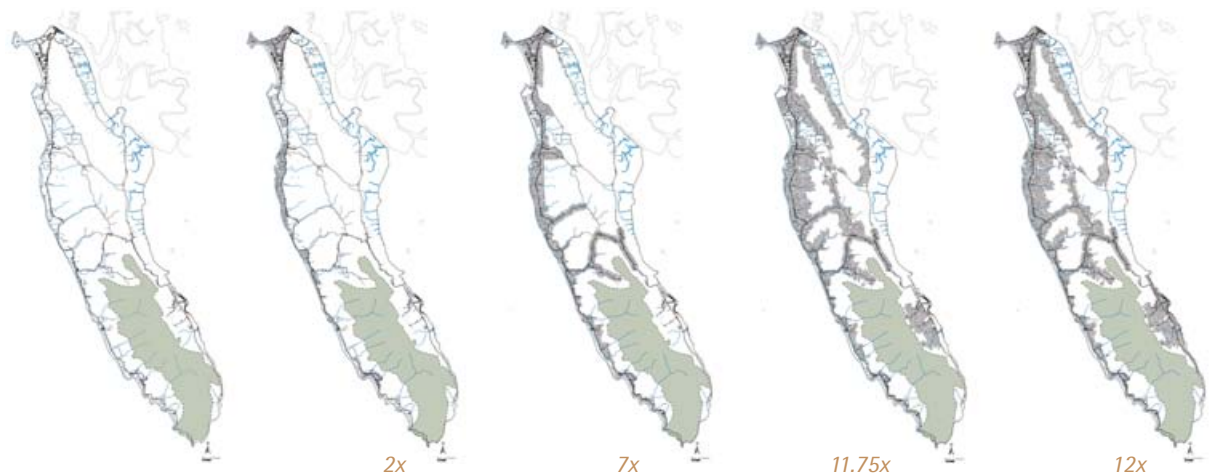


Figure 4. Koh Lanta Yai (left) and Phuket (right).



area faces. It is challenged with management of ecosystems impacts, local and tourism economies, desire for short-term wealth, a lack of enforceable zoning and design guidelines, resource use and waste management.

The buildout scenario map (Figure 2), is based on likely areas of future tourism development. Areas between the main paved road on the west side of the island and beach are at the highest risk for development (in red) followed by areas with flat topography on the other side of the main road and areas along the interior paved roads. These areas (in orange) presently have the largest concentration of tourist facilities and local settlement – they can only be expected to grow. Upland areas that have been cleared of forest are the next likely to be developed (in yellow-green). While many of these areas are presently not accessible by paved roads, the upland development at the Pimilai resort on the southwest sector of the island suggests how these areas could be developed in the future as inclusive, gated resorts. The eastern side of the island is the most remote from present tourist developments and would probably develop more slowly (in yellow).

Comparing the present extent of development on Koh Lanta Yai to the intensity and extent of development on the island of Phuket, the likelihood of this intense development becomes apparent.

Figure 5. Scale Comparison of Development



Figure 3 shows a comparative aerial at the same scale of the two islands. Figure 4 shows a series of comparative photographs which demonstrate many of the problems of development on Phuket are beginning to appear in Koh Lanta Yai. Figure 5 shows a scale comparison of development.

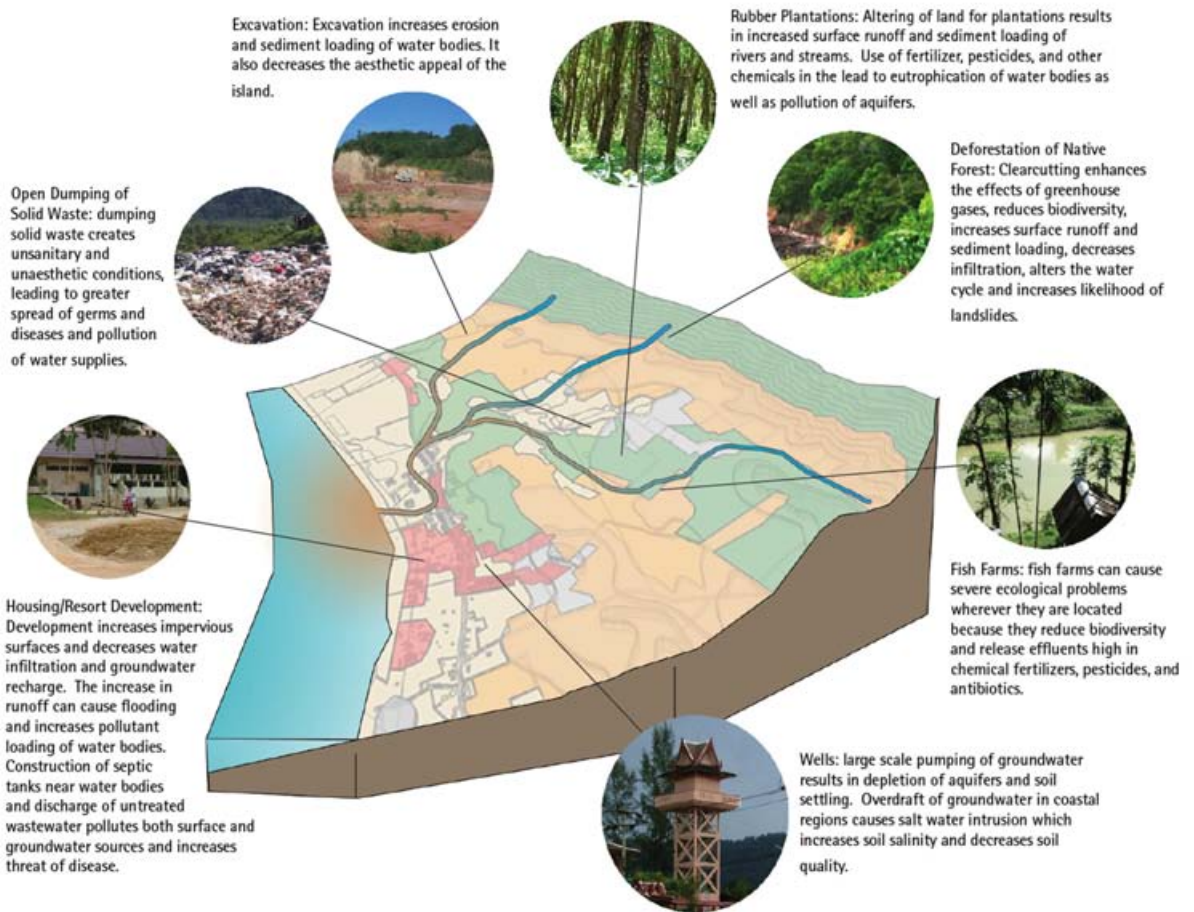
Unconstrained development and rapid destruction of natural ecosystems would jeopardize the lifestyle and livelihood of many island dwellers. Issues of solid waste and wastewater management, water consumption, and destructive construction practices would ultimately destroy the very resource that brings tourists to Koh Lanta Yai in the first place. Koh Lanta Yai's rapid growth is being compared with the rapid growth of Phuket, and, in a worst case scenario, may be analogous. However, Koh Lanta Yai still has legitimate natural attractions, a desire to regulate itself and maintain the 'quiet island' character, and a population that is highly interested and eager to participate in the planning process. We hope this awareness and level of education will engender a feeling of real personal empowerment and the ability to change the likely course of development on Koh Lanta Yai.

Watersheds: Ecological Building Blocks

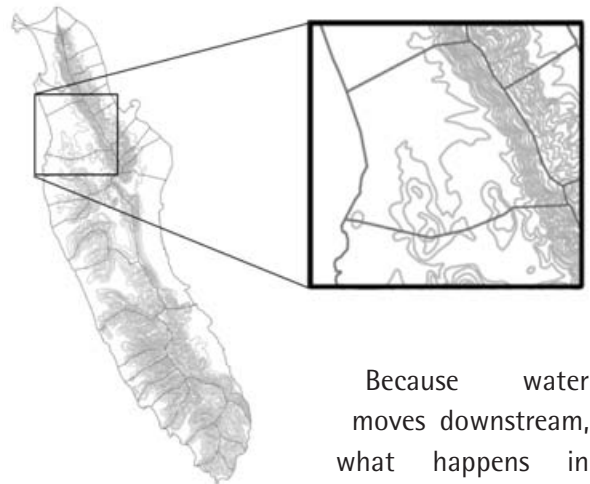
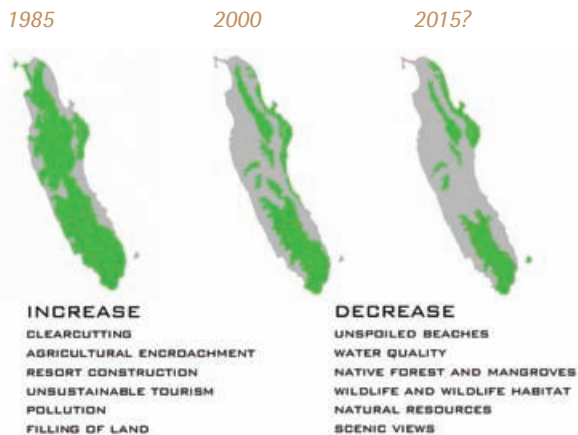
Watersheds are regions that drain downslope into a river, stream, or other body of water through surface and subsurface pathways. Every stream has an affiliated watershed and small watersheds can join to become larger watersheds. If precipitation flows into a specific stream, the area of land where that precipitation fell is part of that water body's watershed. If it flows into a different stream, it is within the boundary of a different watershed. Riparian corridors are composed of watershed streams and the immediate and particular vegetation that parallels the stream. Figure 6 illustrates this process.

Watersheds can be delineated based upon ridgelines and valleys. The ridgelines indicate the highest portion of a watershed and the valleys, which

Figure 6. Typical watershed on Koh Lanta Yai



Destruction of Natural Forests



Because water moves downstream, what happens in one portion of a

often have an associated stream, river, or creek, indicating the lowest portion of the watershed. In order to delineate watersheds using a topographical map, lines can be drawn across the ridgelines, to designate the watershed's boundaries. Using these boundaries, polygons can be formed which show the geographical extent of the watershed.

watershed may have both direct and indirect effects on other portions of the watershed. Poor water quality, or altered water quantity, can change physical, chemical and biological components of the watershed. Not only do alterations of the water quality and quantity in a watershed affect the aquatic ecosystems, but they will also affect terrestrial ecosystems due to the

interdependent nature that aquatic and terrestrial ecosystems often have on one another. Therefore, watershed health can often be used as an indicator of the islands ecological health as a whole.

Koh Lanta Yai is composed of 31 watersheds with affiliated riparian corridors. The watersheds contain all the land uses on Koh Lanta Yai whether constructed or spontaneous. Most important,

the island watersheds are the source of all the water used on the island. (See section **Water Consumption Interviews** for further discussion). Figure 7 illustrates typical watershed usage on Koh Lanta Yai.

The primary tourist draw to Koh Lanta Yai is the beach. Popular tourist guidebooks describe Koh Lanta Yai's beaches as being, "long, unblemished stretches

Figure 7. Watershed Uses



Swimming Pools



Irrigation



Beaches



Fishing



Shared Village Wells



Household Wells

of white sand and turquoise water, with the best conditions for swimming." The quality of this foremost tourist attraction is entirely dependent on the status of the island's watersheds. Inputs from development or agricultural activities, both in the coastal and upland portions of the island, can be carried into the ocean via drainage from streams, and these inputs can be carried back to the beaches by the tides. Excessive sediments, nutrients, and

solid wastes are all forms of pollutants that will decrease aesthetic values of the beach, in addition to being ecologically detrimental.

Watershed Threats

Any kind of disturbance to the landscape surface, particularly forest clearance and construction, exposes soil leads to erosion by rainwater. As rainwater flows over the surface of exposed soil

Figure 8. Watershed Threats



Impervious Surface



Solid Waste



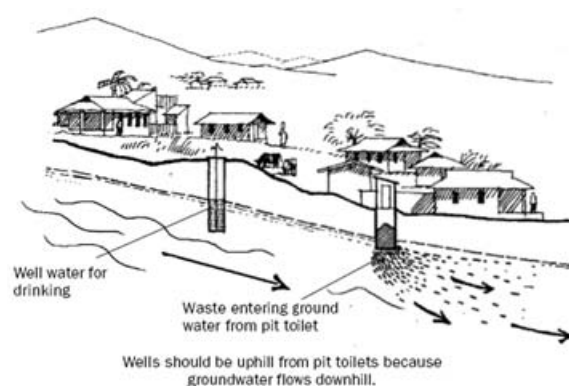
Stormwater draining to ocean



Erosion related to road building



Forest clearance and erosion



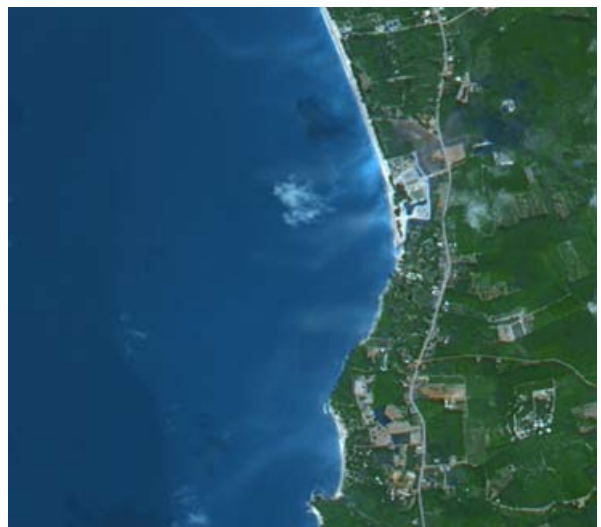
Influence of toilets on watersheds

it dissolves into small particles or sediment that remains suspended in the water and is carried to the sea. Once the freshwater reaches the saltwater of the sea, the sediment deposits on the tidal zone and sea floor. With increased impervious surfaces the flow of water increases as well, adding to its erosive capacity and increasing sediment in its waterways. This process is evident in the "sediment plumes" visible on the aerial photographs of the coast line of Koh Lanta Yai – the streaks of light colored flow extending from the most altered watersheds on the island in the northwest (Figure 8). These watersheds are the most developed on the island with high amounts of impermeable surfaces in their adjacent watersheds. As coastal and upland development increases, sediment plumes will increase and become an accelerating threat. The aerial photographs of the southwest part of the islands where watersheds are not altered show no such plumes.

This process leads to four significant ecologically-destructive conditions. First, the topsoil that supports the vegetation on land is destroyed with resulting loss of land based habitats. Second, the suspended sediment contaminates surface water making it unusable as a water source for local communities and tourism. Third, the deposition of sediment in the tidal zone results in muddy, not sandy, beaches and compromises the health and viability of the mangrove forests and fish habitats that the many island residents depend on for food and livelihood. Fourth, the suspended sediment clouds the water clarity required for the growth and reproduction of coral and deposits over coral reefs, literally suffocating these delicate marine ecosystems. Sedimentation resulting from rapid coastal development is an increasingly severe threat to Thailand's coral reefs. (Sudara et al. 1992) The current tourism on Koh Lanta Yai depends on sandy, clean beaches and the attraction of coral reef diving. Both will soon be lost if the watersheds on island continue to be altered.

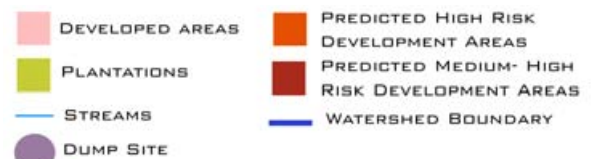
The sources of sediments and contaminants in Koh Lanta Yai's watersheds are evident in the landscape

Figure 9. Sediment Plume Risk Projection



Above, Sediment plumes from typical watershed

Below, Potential change in watershed



conditions of the island. Rubber plantations cover a large portion of Koh Lanta Yai and have drastically reduced the amount of native rainforest on the island. In addition to habitat destruction, rubber plantations can result in sediment loading, fertilizer and pesticide runoff into the watershed. Soil erosion from rubber plantations is a significant problem since many plantations are on sloped areas. Best management practices such as contouring and terracing, mulching, planting cover crops and installing silt pits and bunds can ensure excessive sediment loads do not end up in water bodies and surrounding coastal areas. These are not yet evident on Koh Lanta Yai. In addition, fertilizer runoff from plantations can cause eutrophication, or algal blooms, that occur due to excessive nutrients entering the streams, which will be discharged into the ocean. Eutrophication can result in a hypoxic, or oxygen depleted zone, not allowing for any fish or other oceanic life to survive. Figure 9 illustrates a watershed area with typical sediment plumes and highlights the potential risk areas.

Other agriculture uses also effect Koh Lanta Yai's watersheds. Forest clearing results in large, bare patches of topsoil and less slope stability, thus creating more sediment runoff into the streams which can severally degrade marine ecosystems such as coral reefs. Shrimp farms are a major environmental problem on Ko Lanta, as they are in many other locations throughout south East Asia. Shrimp farms are extremely ecologically destructive as they encroach upon threatened native ecosystems such as mangroves and quickly deplete the areas of all habitat and agricultural values. In addition, shrimp farms release effluents into the watershed that contain pollutants in the form of fertilizers, pesticides and antibiotics.

As development increases, so do impermeable surfaces such as concrete and asphalt. Impermeable surfaces do not allow precipitation and rainwater to seep into the ground as it normally would, therefore reducing water infiltration and groundwater recharge. Instead of seeping into the ground, large amounts of rainwater runoff will go directly into

riparian areas in a short period of time. This can have significant effects on the riparian ecosystem as it can cause erosion of the banks, as well as downcutting of the channel. This results in alteration of the channel's geomorphological characteristics, which may result in an altered species composition of the riparian corridor. Additionally, the runoff can carry higher pollutant loads into the riparian areas due to lack of permeable surfaces to filter the pollutants before they reach the riparian area.

Development has other effects as well. The process of road construction can expose soils, resulting in sedimentation. Paved roads increase the impermeable surfaces in the watershed. Ko Lanta contains a vast number of septic tanks and leakage from these tanks can pollute the groundwater supply. Raw sewage can have devastating effects on aquatic organisms, either by killing them directly or by causing eutrophication.

Solid waste can fall into streams and then be carried to other parts of the island or to the ocean, and eventually onto the beaches. Solid waste can directly kill terrestrial and aquatic wildlife that may ingest it or become physically tangled in it and end up starving to death. Solid waste also adds contaminants and toxins to surface water that people rely on for drinking and can pollute the groundwater through leachate. This type of pollution can lead to greater spread of diseases and pollution. Solid waste is also extremely displeasing aesthetically and will have many detrimental effects to the tourist industry (Figure 10).

Watershed Assessment

The impact that development has had on Koh Lanta Yai watersheds can be determined by the percent of land alteration in the watershed. Land alterations on Koh Lanta Yai include plantations, shrimp farms and urban areas, all of which degrade the watershed due to increasing impermeable surfaces, increasing exposed soils or discharging sediment, nutrients or solid waste into the watershed. In order to determine the current amount of alteration to the watersheds of Koh Lanta Yai, the percent cover

Figure 10. Existing Beach in Koh Lanta Yai (above) and Rendering of Beach with Uncontrolled Development (below).



of the different landuses was determined relative to each watershed using GIS polygons. The percent cover of plantations, shrimp farms and urban areas were added together in order to determine the total percent of land use alteration per watershed (see Figure 11 below). The watersheds were then placed into four categories based on the amount of alteration: Slightly Altered watersheds had watersheds with 0 to 20% alteration, Moderately

Altered watersheds had 20 to 40% alteration, Highly Altered watersheds had over 40% alteration, and Very Highly Altered watersheds had over 60% alteration (Table 1).

Applying this method to the current state of Koh Lanta Yai's watersheds assessed the current state of watershed health. Twelve watersheds were slightly altered, mainly in the southern portion

Figure 11. Landuse Context for Each Watershed

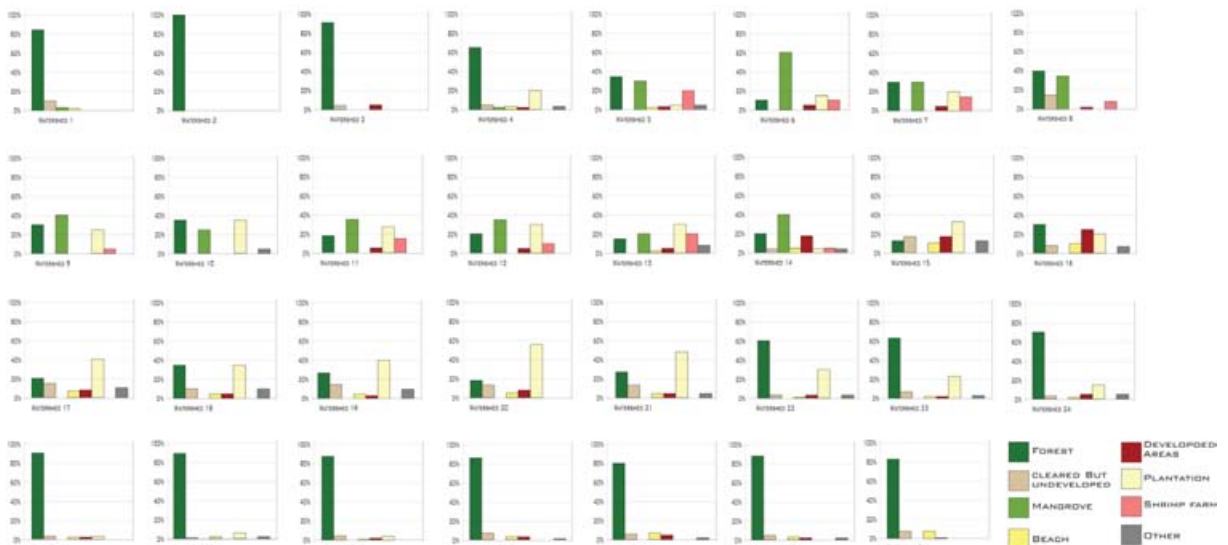


Table 1. Watershed alteration – current states and potential states under projected build out scenarios.

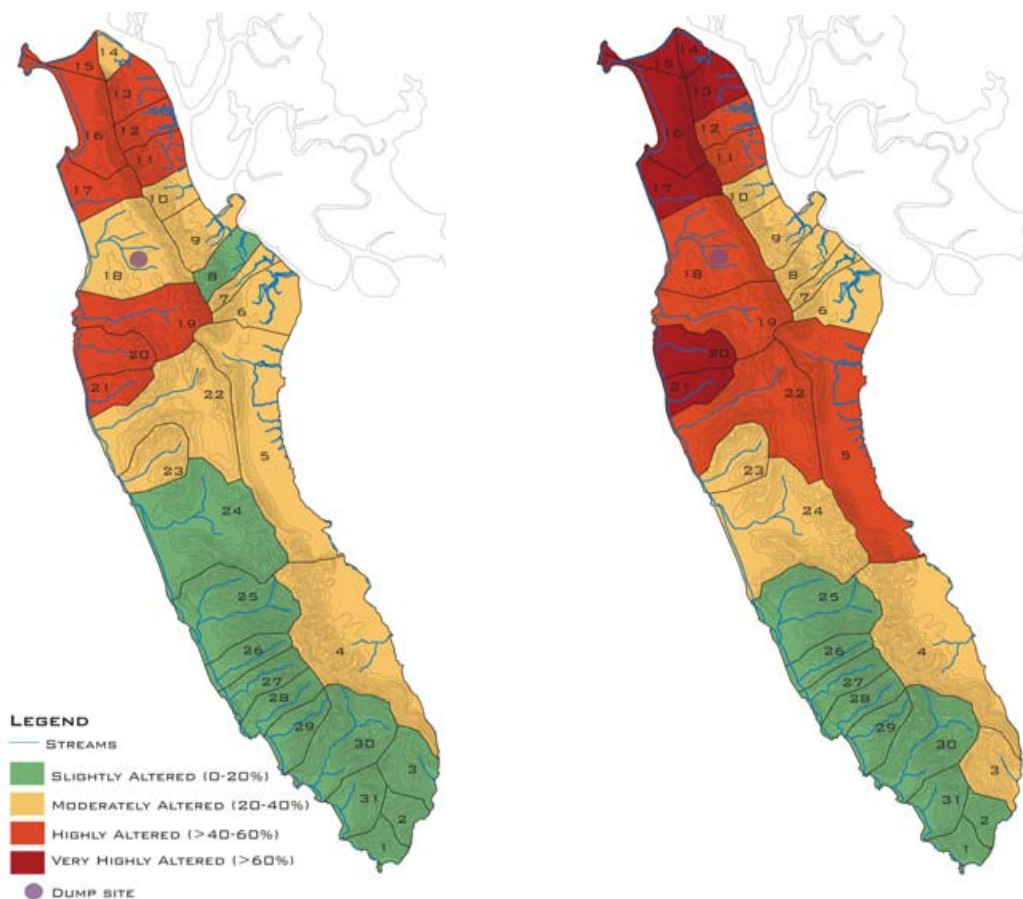
Watershed Health Category	Current Watersheds	Watershed Scenario
Slightly Altered (0-20%)	12	9
Moderately Altered (20-40%)	10	9
Highly Altered (40-60%)	9	6
Very Highly Altered (>60%)	0	7

of the island near or within the national forest. Ten watersheds were moderately altered. The nine watersheds that were highly altered which were mainly in the northeast sector of the island where development is highest. Zero watersheds were very highly altered.

In the case of build-out scenario discussed previously in this report, the same method of combining the projected developed areas with plantations and shrimp farms projected the future for Koh Lanta Yai's watersheds. The results were that nine watersheds were slightly altered, all in the southern portion, nine watersheds were moderately altered, six watersheds were highly altered and seven watersheds were very highly altered.

The prospects for the island's watershed and its surrounding marine ecosystem with a buildout scenario are grim. Only a minority of island watersheds on the west side of the National Park would have any sort of ecological integrity. The remaining watersheds would be noticeably degraded with resulting detrimental ecological and aesthetic conditions for island and surrounding waters. And the buildout scenario assumes that no further forest clearance takes place (Figure 12). Given the forest clearance practices of the last

Figure 12. Watershed Assessment: Current Conditions (left) and Build-out Scenario (right)



twenty-five years this may be optimistic and places the island's watershed integrity at further risk.

Ecological Resources

Koh Lanta Yai plays host to several diverse ecosystems that symbiotically sustain a multitude of terrestrial as well as aquatic resources. These systems are of significant ecological and cultural value to both Koh Lanta Yai's local and tourist populations (Figure 13). The awareness and understanding of the encompassing ecosystems is fundamental to the establishment and success of a long-term sustainable master plan for the island. The nine ecosystems that comprise the majority of Koh Lanta Yai's environment include: tropical rainforest, riparian corridors, wetlands, beach forest, beach and inter-tidal zones, mangrove forests, coral reefs, and oceans.

In recent years Koh Lanta has experienced acceleration in tourist related development. Driven in part by the desire to reap short-term monetary gains, this development compromises the long-

term viability of healthy ecosystems. The lack of ecological awareness and responsibility that characterizes current local and tourist development trends carries with it ramifications that, if left unchecked, will lead to a so called "tipping of the environmental scale." The resulting irreparable degradation of precious natural resources, the island's foremost asset to both local and tourist populations, will prompt the tide of tourism to retreat in search of less adulterated environments and decimate the ecosystem-based local economy.

The ecosystems that comprise Koh Lanta Yai are interrelated. Logically any deleterious activity within one ecosystem is likely to negatively impact the others. All of the nine ecosystems are significant and warrant protection of the integrity of natural functions through careful planning of future development. As Table 2 and the following text illustrate, the nine ecosystems provide key ecological services on the island, yet also are threatened by development practices on the island.

Figure 13. Ecological Resources for Locals (left) and for Tourists (right)

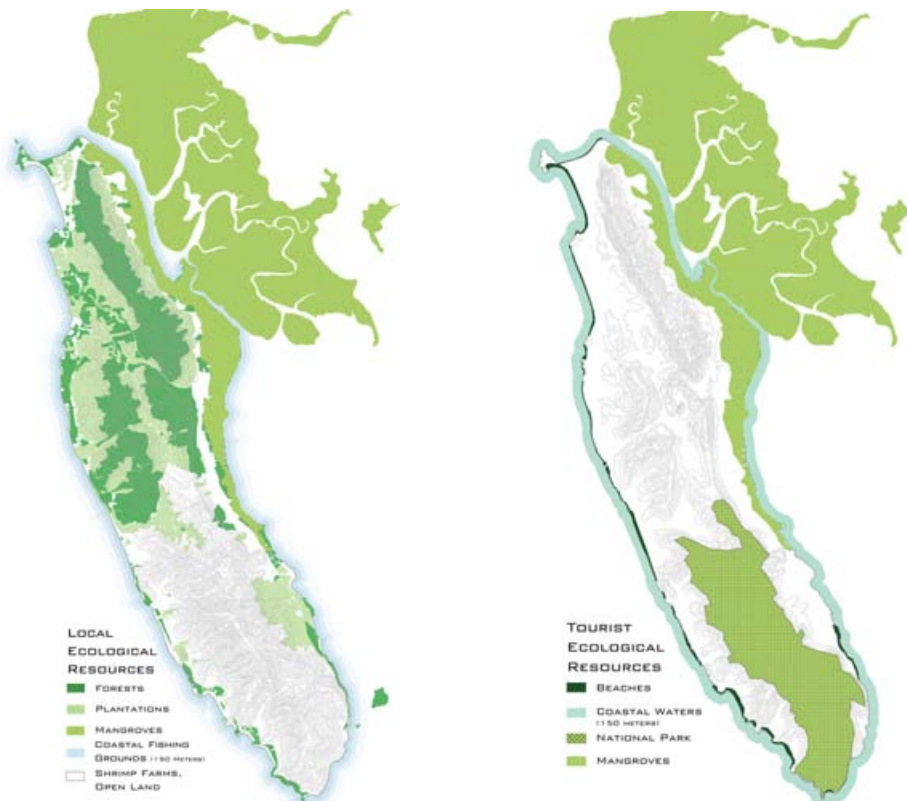


Table 2. Ecological Importance and Threats to Prominent Ecosystems of Koh Lanta

Ecosystem	Ecological Service	Threats	
Rainforest and upland Forested Areas	Significant Habitat	Tourism	Island Growth
	Climate Amelioration	Heavy tourist use	Wood gathering
	Groundwater Recharge	Development of upland resorts	Clear cutting for agriculture
	Erosion Protection		Loss of habitat
	Resource Collection (Wood/Food)		Development
Riparian Corridor	Tourist Attraction		Wildlife trade
	Significant Habitat	Solid and liquid waste disposal	Soil Erosion
	Flood Control		Sedimentation
	Source of Potable Water		Road construction
	Agriculture		Encroaching development
Tourist Attraction	Channelization		
Wetlands	Habitat	Loss of habitat	Loss of habitat
	Water Quality, Infiltration and conveyance	Development	Damming
	Food Production		Channelization
Beach Forest	Habitat	Loss of habitat	Development
	Erosion Control	Over development	Alteration of water table/channelization
	Buffer between inland land uses		Over development
	Windbreak		
Beach and Intertidal Zone	Habitat	Solid and liquid waste disposal	Over harvesting of wildlife
	Purification Zone	Development: waterfront seawalls, encroachment of seaside resorts & villages	Loss of habitat from waterfront premiums on property
	Access to Sea		
	Food Source		
	Village and Resort Development		
Mangrove Forest	Tourist Attraction		
	Habitat	Oil and exhaust from boats/ferries	Loss of habitat from reclamation
	Fisheries	Tourist traffic disturbing wildlife	Waste water effluent from shrimp farms/ households
	Water Storage	Decrease in water quality due to development related sediment inputs	
	Erosion Control		
	Flood Control		
	Buffers Wave Action		
	Food Source		
Coral Reef and Ocean	Wood		
	Tourist Attraction		
	Habitat	Watercraft noise and emissions	Sediment/nutrient loading from construction/erosion
	Fisheries	Boat anchors destroying coral reefs	Loss of habitat
	Buffers Wave Action		Black market shell trade
	Tourist Attraction		

Rainforest

Koh Lanta Yai is fortunate to still possess significant tracts of rainforest, mostly in the upper elevations on slopes unsuitable for efficient agriculture. While the forested areas are dispersed along the length of the island, the largest contiguous portions are situated in the south within the National Park. The rainforest ecosystem is known for containing extremely high biodiversity and as such has been the focus of extensive conservation efforts throughout the world (Figure 14). Despite efforts over the last twenty to thirty years the world's remaining intact rainforests are being lost at an alarming rate to logging, cattle grazing, agriculture, and development. With each passing year these remnant ecosystems take on greater and greater significance not only as repositories for biodiversity and the important ecological functions they perform, but also as tourist destinations. Existing Thai statutes theoretically prohibit the clear cutting of rainforests but in the last 20 years Koh Lanta Yai has lost one third of its rainforests to plantations and development. Local authorities do not or cannot enforce existing laws.

On Koh Lanta Yai, the forested areas have traditionally supported selective harvesting of vegetation and wildlife by local residents. In addition, they also perform the essential function of recharging groundwater through the promotion of precipitation infiltration while simultaneously buffering soil erosion, directly influencing potable water availability.

On tropical islands such as Koh Lanta Yai, with highly erosive soils and steep slopes, forested areas play a pivotal role in mitigating soil erosion through two main functions: interception and dispersal of heavy rains by dense multi-tiered foliar canopies and binding soils with extensive interwoven root and micorhizal systems.

Currently, access to rainforest areas is limited to a few, unimproved roadways. However, this will soon change with new road improvements to the National Park on the southwest side of the island. The increased vehicular access is likely to further disrupt wildlife and alter habitat quality unless measures are taken to minimize impacts. Tropical rainforests are particularly susceptible to an impact know as "edge effect," in which harmful effects of adjacent land uses (such as clear-cutting for rubber plantations or grading for new roads) manifest themselves beyond the ecosystem interface.

Riparian Corridors

Riparian corridors are the vegetated zones immediately adjacent to water bodies such as rivers and streams. The proximity of terrestrial and aquatic conditions leads to high flora and fauna diversity. Long identified as biodiversity

Figure 14. Rain Forest Habitat on Koh Lanta Yai

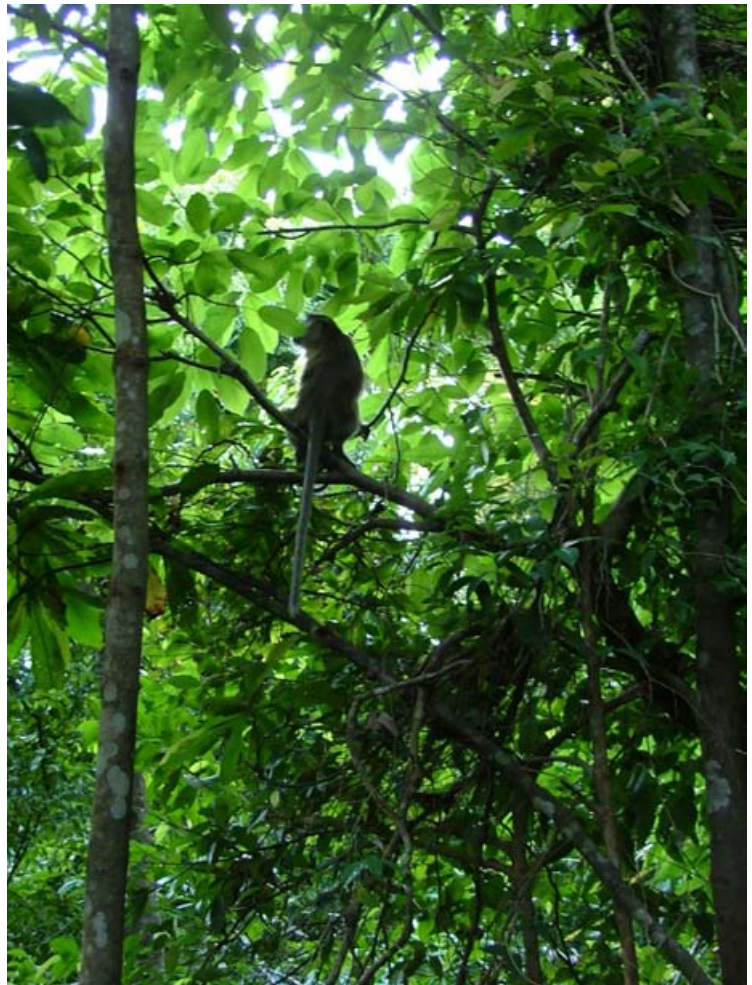


Figure 15. Riparian Zone (left) and Channelized Stream (right)



hotspots, the burgeoning ecotourism industry recognizes riparian ecosystems as popular tourist destinations.

These ecosystems provide numerous ecological functions including wildlife migration corridors upon which population viability is commonly dependent. In addition, they act as self-regulating storm water conveyance and mitigation systems, the proper function of which directly influences water quality, availability, and flood hazard. As the last terrestrial moderator of sediment transport, these ecosystems play a pivotal role in regulating the loss of topsoil – thus their preservation is critical to Koh Lanta Yai's sustainability.

Road building and agricultural practices such as clear-cutting remove riparian vegetation, not only compromising the ability to retain soil but actually promoting mass-waste as the toe of the stream bank is destabilized. This results in unnaturally high sediment loads which adversely impacts water quality. Development encroachment through wholesale removal of riparian vegetation, and channelization of the remaining watercourse, is becoming a common practice in Koh Lanta Yai's lower elevations with potentially disastrous consequences. As channelization proceeds upstream with development, it increases the likelihood of flooding in lower portions of the watershed, directly threatening human and existing development (Figure 15).

Wetlands

As streams arrive at lower, flatter elevations on the island, the water decreases in velocity and expands over a wide area to form wetlands. Sharing many of the functions and threats as those of riparian corridors, wetlands are high in biodiversity and particularly susceptible to development and associated impacts. Acting as natural water filters for nutrients and sediment, they have a direct influence on water quality and the health of coastal waters. Their biodiversity has long made them a valued source of food for Koh Lanta Yai residence. Wetland loss to filling and stream channelization is an ongoing occurrence on Koh Lanta Yai. Ecosystem loss to land-use such as agriculture and resort development results in alteration of the hydrologic cycle. Related negative impacts include habitat loss, increased impervious surfaces that reduce groundwater recharge, and impaired water quality through the introduction of pollutants such as liquid and solid waste.

Beach Forest

The island's beach forests are found in the more exposed coastal areas with wind and water availability acting as primary controlling factors in vegetation composition and density. These forests provide valued buffers to strong winds, mediating storm severity in the inland areas. The root systems of common tree species such as Casurina pines protect against erosion by stabilizing soils. They provide habitat for numerous species, primarily

Figure 16. Beach Forest, Beach, and Intertidal Zone



birds, and offer the additional benefit of screening adjacent development.

Local communities have long resided within this ecosystem type, favoring the access to resources it affords. As a result of its proximity to coastal waters, the recent tourism increase and guesthouse/resort development have exerted tremendous pressure on this ecosystem. The practice of stream channelization, especially following the 2004 tsunami, led to the destruction of beach forests, loss of wildlife habitat, increasing sediment erosion, and decreasing aesthetic appeal.

Beach and Inter-tidal Zones

The islands white, sandy beaches are the primary draw for thousands of tourists and they also play an integral role in local culture. This ecosystem type circumscribes the island, with the greater concentration of high quality tourist beaches such as the Klong Dao and Phra Ae Beach located along the western coast (Figure 16).

Constituting the foundation of Koh Lanta Yai's tourism industry, these ecosystem types are the focus of intensive resort development. Heavily used by tourists and locals alike, they provide access to

the ocean and activities such as food collection, swimming and diving. Important ecological functions must not be overlooked, including water filtration, and wildlife habitat.

The increased tourism development and resultant discharge wastes threaten this ecosystem, potentially jeopardizing both the ecological and tourism value of the beaches and intertidal zones. The continued construction of waterfront seawalls and coastal resorts is

likely to negatively impact the aesthetic quality of the areas for tourists. If unregulated, development will dominate the beach landscape and potentially sever local access to the coast.

Mangroves

Home to numerous range of aquatic, terrestrial, and avian wildlife species, Koh Lanta Yai's mangroves span the north and eastern coasts (Figure 17). Similar to rainforests, the global recognition of the dwindling numbers of these sensitive ecosystems has prompted widespread conservation efforts. They provide several important functions on Koh Lanta Yai. Mangroves buffer wave action (potentially of critical importance in areas susceptible to tsunamis), trap sediment that might otherwise impair water quality compromise coral reef habitat, and are long standing foundation of the Thai Mai culture. Recently this ecosystem has received attention for its significant potential as an ecotourism attraction. Local villagers have established the Mangrove Education and Eco Tourism Center (Thung Yee Pheng Eco Tourism Center) on the east side of the island. (Figure 18). Despite conservation efforts, Koh Lanta Yai's mangroves remain threatened. Several specific activities are of particular concern. The use of

motorboats discharge oils and exhaust pollution and loud motors disturb wildlife. The practice of clearing mangroves in order to increase developable land and infrastructure projects result in ecosystem fragmentation and loss of wildlife habitat. Effluent from shrimp farms and households pose additional threats to mangrove forests from polluted chemical and sewage laden waters.

Coral Reefs

These ecosystems support an abundance of distinct aquatic species and, like rainforests, are the object of conservation efforts throughout the world. Like beaches, Koh Lanta Yai's coral reefs and coastal waters are primary tourist attractions. Scuba diving is a thriving island enterprise and the reefs off Koh Lanta Yai are world class. The coral reefs also serve as a significant source of food and revenue generation for a large portion of local people, notably the Thai Mai.

Yet the unconstrained, unregulated development on Koh Lanta Yai fundamentally threatens the

continued survival of the coral reefs. Destructive construction practices, readily seen throughout the island, loosen and expose soil to the erosive process of the heavy monsoon rains. Suspended sediment then collects in watercourses and makes its way to the sea. There the sediment is discharged, falling to the sea floor and on to the coral reefs. The delicate coral that depends on crystalline seawater for habitat is literally suffocated by the sediment. The coral reef, and the great quantity and diversity of species that depends on it, dies; the most unique tourist attraction of the island will also be gone. This process is slow but it is continuing and will soon be irreversible in the coral reefs of Koh Lanta Yai.

Ecological Preservation Priority

The identification and prioritization of ecosystems and their assets is of particular importance to the overall sustainability of Koh Lanta Yai. Based on findings, the following ecological resources are prioritized into five categories. Figure 19 illustrates these categories.

Figure 17. Mangroves and Waterways



Figure 18. Thung Yee Pheng Eco Tourism Center



Highest - Riparian corridors, Freshwater/Saltwater Interface

Connecting all of the ecosystems, riparian corridors and the zone where they meet the sea are at the core of healthy ecosystem function of the island. Securing these areas will significantly mitigate the many assaults on the island ecosystems, particularly issues of erosion and sedimentation, and reinforce stewardship efforts in the adjoining ecosystems.

Higher - Rainforests (National Park), Mangroves, and Coral Reefs

These resources bear direct relation to the health and sustainability of the beaches and coastal waters. Rainforests on steep slopes stabilize soil that might otherwise have impact downstream. Upland forests recharge the aquifer and slowly release surface water insuring continued water supply on the island. Mangroves are essential to fisheries and protect the sea and coral reefs from sedimentation. Existing policies strive to protect these resources but it is important that they are locally enforced.

High - Beaches

As one of the primary tourist attractions, the beaches are a valued resource which might suggest that they be given highest priority, but their well-

being is largely dependent on the health of the riparian corridors, forested areas, mangroves, and coral reefs.

Moderate - Plantations

The plantations are an ecological resource, as they provide buffer between urban development and upland natural resources such as forested areas. They also serve as a local economy distinct from that of tourism, and provide limited wildlife habitat. Plantations can increase their positive ecosystem effect through the use of management practices that mitigate runoff and increase habitat value.

Low - Shrimp Farms, urban areas

Both shrimp farms and urban areas have the potential of providing ecological resources, such as wildlife habitat, if planned and managed properly. Currently their impacts constitute far greater ecosystem threat such as water pollution, impervious surfaces, and sediment.

Ecosystems, Resource Use, and Stakeholders

Koh Lanta Yai's ecosystems, their functions, and island stakeholders are intricately connected and highly codependent. While certain ecosystems are more resilient to disturbance than others, the island's ecosystems remain fragile environments. The future sustainability of Koh Lanta Yai depends on maintaining thriving, healthy ecosystems as resources for tourists and locals alike.

Infrastructure

Infrastructure

The management and planning of infrastructure is one of the most pressing problems on the island of Koh Lanta Yai. Koh Lanta Yai struggles to adequately meet the infrastructural needs of both its local population and the tourist industry. The tourism industry places significant demands upon the island's finite resources, especially in comparison to the local demands. There is no comprehensive monitoring or regulation of the use of the islands

Figure 19. Ecological Resource Preservation Priority

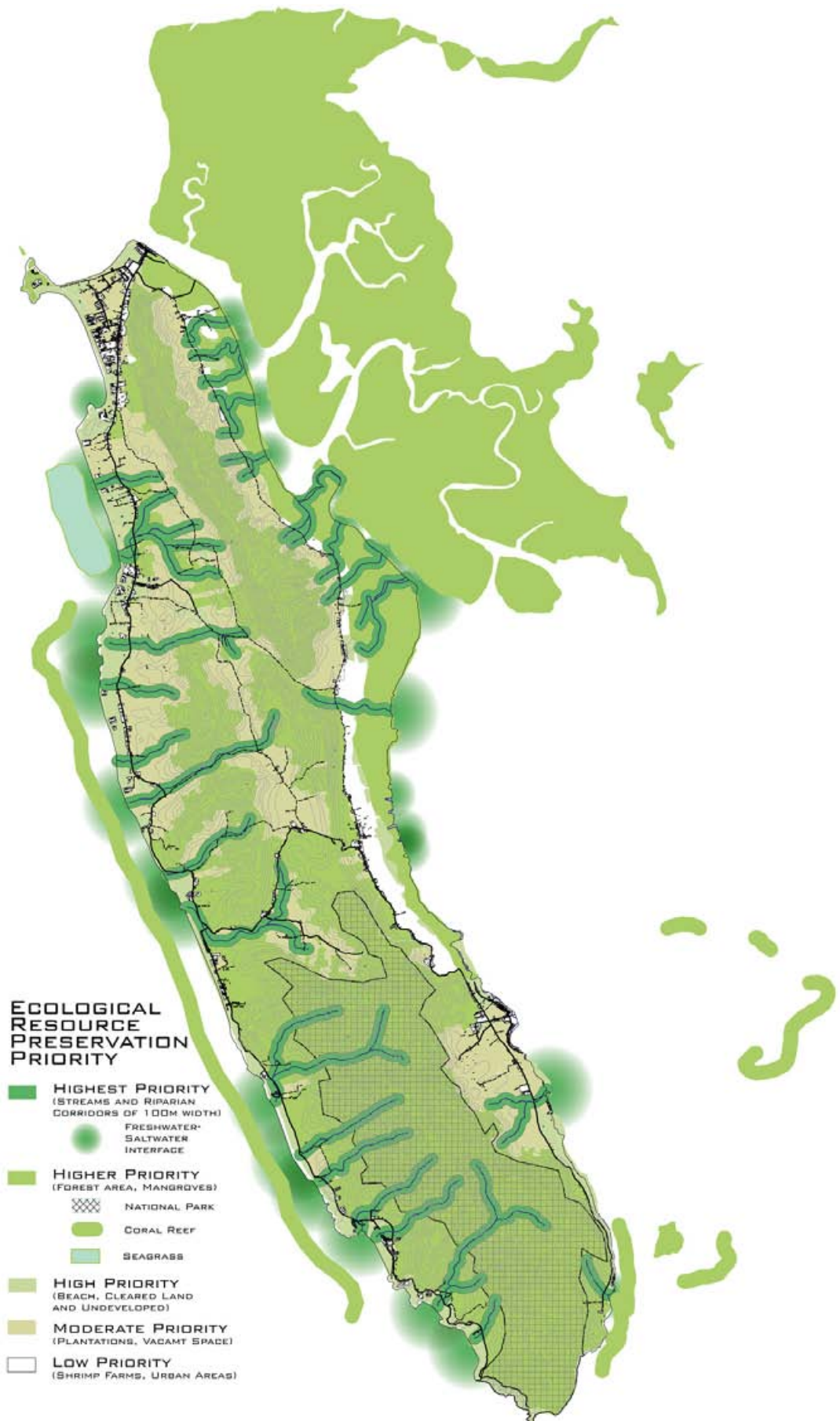
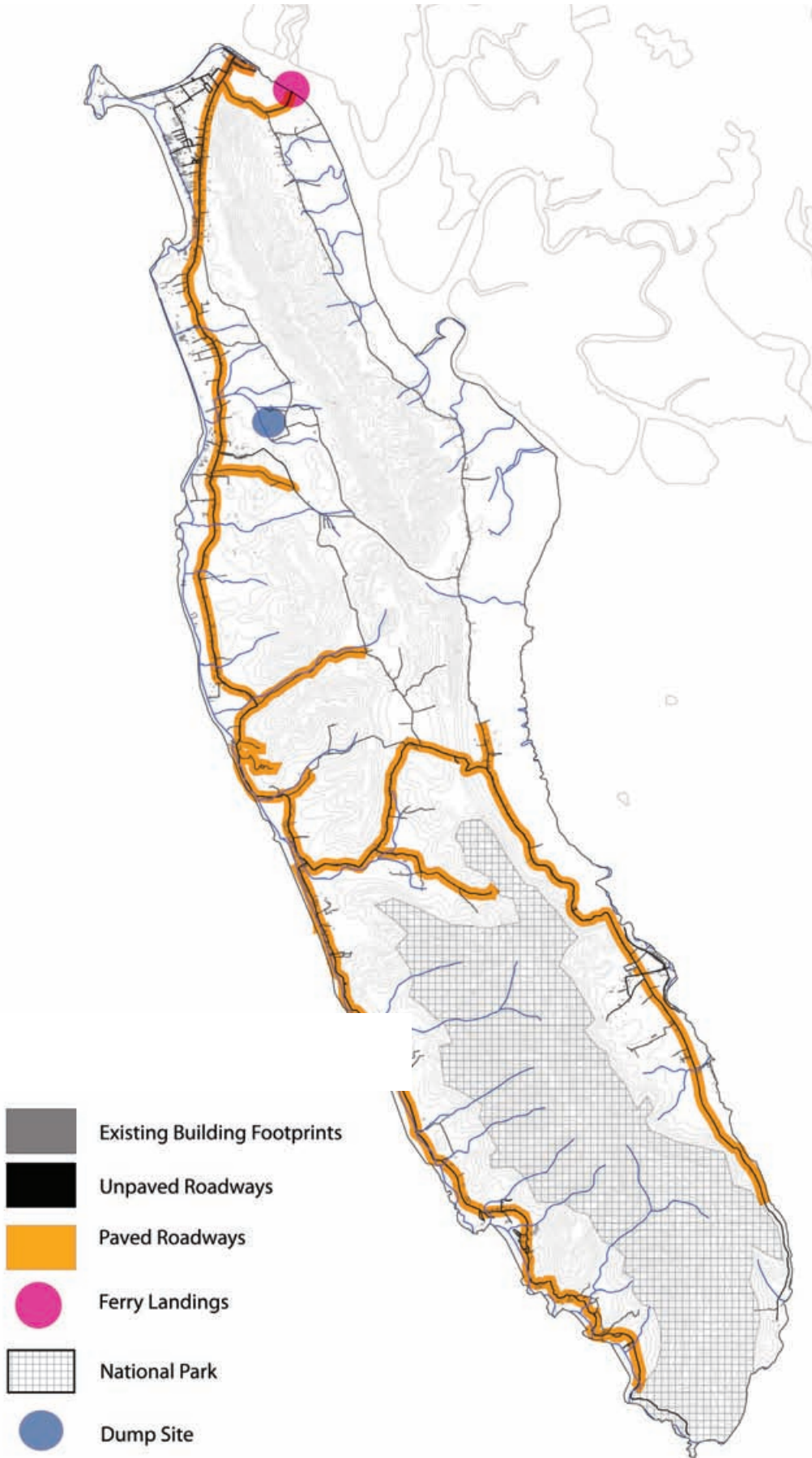


Figure 20. Existing Infrastructure Map



infrastructure and resources to ensure equitable use and meet future needs. Figure 20 illustrates the existing infrastructure on Koh Lanta Yai.

There are five critical infrastructure sectors requiring immediate attention to enable local equity and the future sustainability of the tourism: roads and traffic, bridge connections to the mainland, resource use, saltwater intrusion, and solid waste. Continuing under current conditions, without addressing infrastructure problems, will result in destruction of the unique environment and way of life that makes Koh Lanta Yai such a popular tourist destination and special place to live.

Roads and Traffic

Currently, the island of Koh Lanta Yai is experiencing a significant amount of new road development. The central government has focused efforts of infrastructural development on building new roads and widening existing roads on the island. During the summer of 2006, the tourist off-season, there were a number of new roads being constructed or widened.

The focus on development of new roads is misguided considering the other, and more pressing, infrastructural needs of the island. On an island where traffic is limited by a ferry, the development of new and wider roads enables greater amounts of tourist traffic that have adverse ecological and social effects on the island. In addition, wider roads encourage drivers to drive at higher speeds presenting significant safety hazards for both drivers and pedestrians.

The existence of more roads and the process of road building also have severe consequences on the environment. In order to build new roads, ecologically valuable forests are cut down, and often swaths of forest 2-3 times the width of the road are sacrificed in the construction process. In addition, during the construction of new roads, soils are harvested from one area of the island to be used to level the roads in another. This practice creates multiple opportunities for erosion both where the

soil is taken from and where it is placed. Loose and exposed soils erode into waterways during construction, especially since most construction takes place during the rainy season.

In addition to erosion during the construction process, the existence of roads has a direct effect on habitats and watersheds. Paved roads cause fragmentation of native ecosystems, resulting in a reduction of habitat diversity. Roads are impervious surfaces, meaning that when it rains the valuable resource of water washes off the roads rather than being absorbed by the ground to replenish the island's aquifer. Thus, more roads create more impervious surfaces on the island, which translates to a depletion of the island's water resources.

Traffic on the main west coast road during the high season is considerable – the road was widened after the tsunami, and central planning authorities propose further widening of the road, including the paving of the road into the National Park. With continued tourist development, the west coast road will become a significant detractor to the island character as noise, pollution, dust, and congestion will increase. The island provides a very limited public transportation system, too expensive for most locals. No bike paths exist on the island that could provide an alternate, energy saving, and non polluting mobility system that would be especially compatible with tourism development – a tourist attraction in and of itself.

Ferries and Proposed Bridge Connections

Currently, Koh Lanta Yai is only accessible by ferry from the mainland. This year-round ferry system has two segments – one ferry connects Koh Lanta Yai to Koh Lanta Noi, and the second ferry connects Koh Lanta Noi to the mainland. During the high season, ferries connect Koh Lanta Yai to other islands in the Andaman Sea and directly to Krabi City. A current proposal suggests building either one or two bridges to permanently replace one or both segments of the year-round ferry. The biggest problem with the ferry system is its inconsistent schedule – running only when they are full;

leaving the passengers at the mercy of the ferry operators. Also, the ferries have no late evening service to allow for emergency medical access, except at an exorbitant price well beyond the means of most locals.

As a part of the ferry company's contract with the government there are stipulations about the service to be provided to the island. Obviously, the ferry company is not honoring this contract to provide proper service. Thus, the government has the ability to enforce its contract with the ferry or search for a competitor that will honor the contract (Figure 21).

The proposed bridge would have a number of consequences that need to be fully explored before any definitive decision. Building a bridge would cause a significant amount of damage to mangrove forests that are adjacent to the proposed bridge sites. Proponents for the bridge state that it would increase the amount of tourism on the island. Yet tourism industry disproportionately produces the majority of the environmental impacts on the island, particularly solid waste. (See Table 3). Thus, increasing the daily population of tourists on the island will exacerbate the solid waste and other environmental problems on the island. In addition, a new bridge would also introduce more cars to the island. More cars would mean more land dedicated to parking lots, faster traffic and significantly more pollution.

Table 3. Resource Consumption Rates of Tourists Per Day According to Tourism Destination (Source: Strategic Plan for Sustainable Tourism Development in Krabi Province. 2005)

Hotel Size	Water Consumption (in liters)	Wastewater (in liters)	Solid Waste Production (in kg)	Energy Consumption (in kwh)
Small	180	150	3.23	13
Medium	260	180	6.67	36
Large	285	200	10.10	51

The lack of direct access to Koh Lanta Yai also adds to the tourist value of the island. The isolated feel of Koh Lanta Yai is one of the main draws to the island and significantly contributes to its unique, exclusive appeal. Creating direct access could ruin this island character and expand mass tourism on the island. Overall, there could be no financial gain for the tourism industry with the loss of higher priced, more exclusive tourism.

Energy Resources

Electricity, the most widely used energy resource on Koh Lanta Yai, is supplied from the mainland by a recent, federally funded infrastructure system. The electricity system is fairly cohesive – reaching most of the island – and suffers the predictable minor electricity outages. Because the system is comprehensive and electricity is in limited supply the considerations of energy are not about equity of access, but of unnecessary consumption.

Figure 21. Present Ferry Service (left) and the Proposed Efficient Ferry Service (right)



The Koh Lanta Yai region of Thailand has a very specific traditional bungalow-style architecture which responds to the availability of natural resources and the local climate. Typically, such houses are raised off of the ground, have high roofs, and are set discretely within the landscape to take advantage of the sea breezes. These forms elegantly utilize passive ventilation to cool the houses. The traditional housing structures are also made of local materials, many wood or bamboo, which may need to be replaced, but are readily available because of the local supply.

Very few of the tourism developments have taken the opportunity to learn from this traditional regional architectural style which responds to the local environment. Instead, many of the tourism developments are more generic in their design, influenced more by international architectural styles and mass-produced building materials. Thus, these developments have inherently greater energy demands as a result of the need to light and cool the buildings mechanically. In addition, the tourism developments predominately use materials such as concrete, steel and wood which are not local. The need to transport these materials to the island also results in high energy costs during the construction process. Figure 22 indicates that the larger the hotel size the greater the amount of energy consumed by visiting tourists.

Certain existing tourist resorts on the island have considered the local architectural style. Placement of buildings creates a unique atmosphere and sustainable development. The Narima Resort has

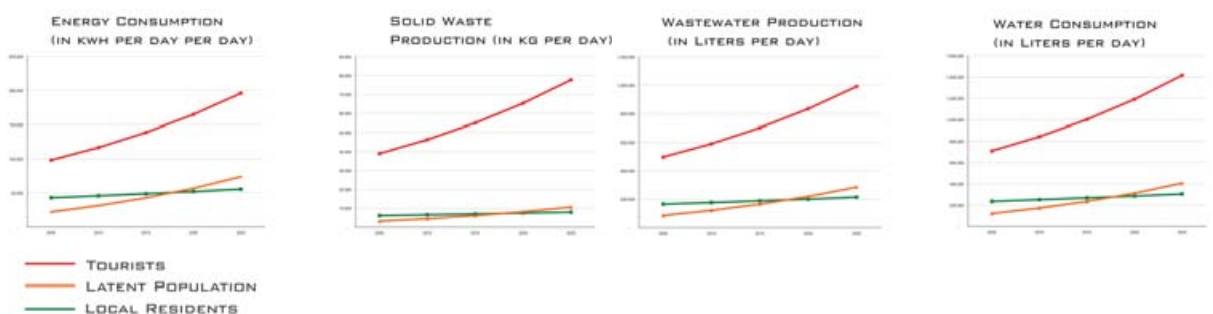
built their guestrooms in the local bungalow style. In addition, the bungalows sit within the surrounding forest, which was preserved during development. The forest shades the structures and lowers energy use, which saves the resort money by allowing for the use of natural ventilation, lighting, and cooling. In addition to being energy efficient, Narima's careful dedication to traditional architecture creates a distinct, selective, and aesthetically pleasing environment that offers the tourist a historical and environmental experience unique in Koh Lanta. Narima Resort is the opposite of most other island tourist developments that destroy the surrounding environment placing obtrusive, energy-inefficient structures on sites denuded of vegetation.

Water Resources

As a tropical island, Koh Lanta Yai experiences abundant rainfall during the monsoon seasons. On average, rainfall over the island ranges from 2200-2400 mm/year or approximately 350 million cubic meters of rainwater per year. There is limited data available on what fraction of this total rainwater is actually harvested and used either for potable or irrigation purposes. However, space for storing water is a constraint on the small island, making rainwater collection difficult.

In addition, Koh Lanta Yai is located over two large aquifers. Though the soil type allows for large amounts of water storage, the karst aquifers produce hard, turbid water that, although not harmful, is not suitable for drinking purposes without additional filtration and treatment.

Figure 22. Energy Consumed by Tourists



In Koh Lanta Yai, water is one of the natural resources most impacted by the rapid rate of development. Currently, there is no one water supply system providing water for the island. Hotels and larger business are able to build their own water supply systems. Most local people are left to provide their own water. Although a large water supply system capable of meeting both local and tourist demand could assure safe, clean drinking water and minimize many of the currently observed problems, the financial and environmental cost of building such a system is prohibitive. The island is in dire need of better management practices to provide a consistent water supply to local inhabitants and to regulate the tourist water supply.

Locals provide for their water needs through rainwater harvesting, limited mountain spring water, surface water, village and individual wells, or purchase of bottled water. However, the greatest water demand occurs within the dry season when the monsoon rains do not replenish the streams or fill the harvesting cisterns, and water becomes a scarce resource. Water is available in a variety of ways, but locals are forced to spend a lot of time, energy, and money to make sure they are able to meet their basic water needs (Figure 23).

Currently, most drinking water is treated, bottled water which is either manufactured on the island or imported from Krabi. There are two island plants which bottle drinking water. These plants extract groundwater that is then treated with sand filtration and UV disinfection. They produce about 1400 liters a day during the low season and 2400 liters a day during the high season. At a minimum, bottled water sells at 20 liters for 10 baht, a significant cost to locals of mostly modest means.

According to the United Nations and the World Health Organization, humans need at least 20-50 liters of safe clean water every day. (Gleick 1996) According to a survey conducted by the Pacific Institute on the World's access to safe drinking water in both rural and urban areas, from 1970-

2000 over 20% of the world's countries still have less than 50% of the people with access to safe drinking water. Unfortunately, the water resource situation for a significant number of local people on Koh Lanta Yai falls within this 20%. (www.unesco.org/water/wwap/facts_figures/basic_needs)

The local government is ineffective in meeting local water needs. For example, in Thung Yee Pheng Village, the TAO built a well that was not strong enough to pump water to the storage facility, so the village went to the central government (Ministry of Public Health) to have an adequate well built. However, even this well produces marginally – there are not enough financial resources to ensure year round operation, maintenance, and monitoring. According to locals, they still need to purchase drinking water, at the very least, for their children.

The high demand for water by tourism has fueled management and allocation problems, reaching severe conditions in the high season and constricting local access to water. Resorts provide for their own water supply through private wells and treatment systems. More rarely, they resort to surface water collection and treatment systems. On Koh Lanta Yai, resorts use large quantities of water in their day to day operations. Many high-end resorts on the island have an abundant number of swimming pools to maximize their guest's experience on the island. Irrigated non-native landscape plants, while adding to the aesthetic appeal of resort areas, also divert water supplies. Native species adapted to the monsoon dry season cycle require little or no interim irrigation.

Field research in Koh Lanta Yai indicates that a family of 6 with some means consumes 1000L per week or 23L per person/day while data from last year's report indicates that the daily water consumption for tourists at medium scale resorts is approximately 260L per person/day. Those who are able to provide water through private wells (hotels, resorts, some businesses), incur the initial infrastructure cost of groundwater wells and

Figure 23. Water Consumption Interviews



1. Restaurant Owner in Saladan Village

The restaurant extracts water from a local well and uses that water for washing floors and dishes. The well has salt intrusion and cannot be used for cooking and drinking. They also collect rainwater for the same purposes, but this service fluctuates with the seasons. For cooking and drinking, the owner purchases fresh water from the mainland that is delivered by a truck. The cost is 150 baht for 1000 liters. She uses about 3000 liters a week during the low tourist season and 4000 to 5000 liters a week during high season. She added that, in general, shop owners in Saladan Village can't easily collect rainwater because of a lack of storage space and lack of rainwater volume available in this location of the island.



2. Residential Home Owner in Saladan Village

A man who built his own small, two-bedroom home shares this space with his wife and three children. The family uses roughly 1000 liters of fresh water every 7 to 10 days for cooking, drinking and bathing. The water is delivered by a truck and the source is from a well in the northeast area of the island. In the rainy season, they also collect rainwater from the roof, storing it in a small cistern and use it for washing floors and areas of the house.



3. Owner of a Private Well near Saladan Village

Just beyond Saladan Village in the northeast is a privately owned groundwater pump. The operation taps into the aquifer and can store up to 20 000 liters (there are 10 large plastic cisterns, each with a capacity of about 2000 liters.) The owner has a truck and fills it with water to sell to locals on the island.



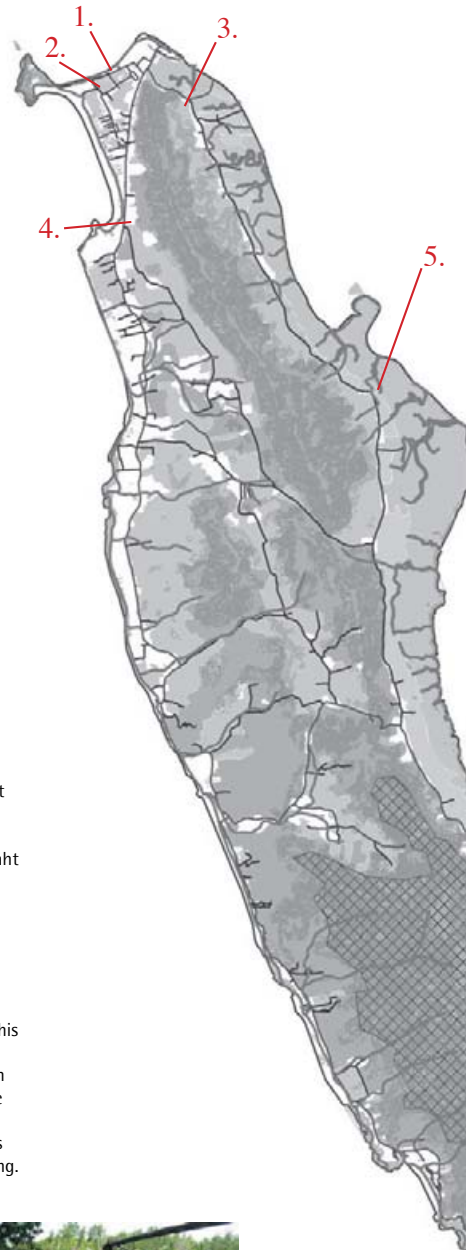
4. Owner of a Health Clinic south of Saladan Village

The owner, who is also the head doctor at this small health clinic at the southern end of Kah Kwang Beach along the main road, primarily treats tourists. Her clinic uses, on average, 1000 liters of fresh water every 2 days. She said her bill for water use was 150 baht per day. Her fresh water was delivered by truck from the mainland.



5. Village Headman on the East Side of Island

The headman of a small village in the northeast area of the island said 10 years ago the Department of Public Health built a well for his village. The islanders later became responsible for managing and maintaining the well. This village has 152 households, 130 of which are covered by the current water system. During the dry season the well typically runs dry. Piped water, derived from a surface spring water source is available when the well is dry. The piped water runs to households for 3 hours in the morning and 3 hours in the evening.



filtration and treatment systems, but then are free to use large amounts of water limited only by the available aquifer supply. At the same time, those who do not have access to private wells and obtain their water through rainwater harvesting, local wells and springs, and purchase of bottled water, bear a larger burden to meet their basic water needs, and thus sparingly consume this precious resource. There is no mechanism on the island to recognize this inequity of water resources.

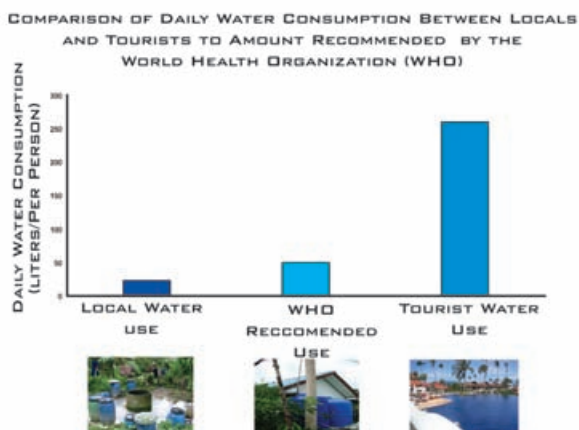
Water Quality

There are multiple reasons that account for the water quality issues on Koh Lanta Yai, some due to natural geologic landscape while others are due to mismanagement of resources.

The islands geologic make-up poses some difficulty to using groundwater for drinking purposes. Treatment technologies capable of reducing turbidity and other problems found in the available well water more affluent private households and resorts to provide their own drinking water. However, a dependence on groundwater coupled with the rapid rate of development will pose problems for Koh Lanta Yai. Current development clears forests and creates extensive impervious surfaces reducing the ability of water sources to be naturally replenished through slow runoff rates, infiltration, and recharging. (See also Figure 24).

Unmitigated development practices on Koh Lanta Yai's exacerbate this condition. Sediment,

Figure 24. Salt Water Intrusion.



agricultural runoff from rubber plantations, and effluent from shrimp farms contaminate water resources. The island's inadequate wastewater and sewage practices contribute very significantly to the declining water quality. Currently, most wastewater and sewage are either sent to pit latrines, septic tanks, or discharged directly into the sea. There are no enforceable regulations governing the construction of latrines and septic tanks and their proximity to water supplies and water bodies. The World Health Organization recommends that septic tanks and pit latrines must be a minimum of 20 meters from any surface water body or well, and must be placed downstream or downhill from nearby water bodies. This is not usually the case on Koh Lanta Yai.

Local regulations on Koh Lanta Yai require that hotels and resorts with more than 90 rooms build their own wastewater treatment facility. However, many resort owners manage to avoid these regulations by building just under 90 rooms and discharge untreated waste to the streams and ocean. The consequence of multiple owners engaging in this practice results in unsustainable amounts of polluted water being discharged into the environment.

Currently, water quality monitoring occurs only when there are outbreaks of water borne illness such as diarrhea or dysentery. Comparison of such water quality testing with results from the United States Environmental Protection Agency, which governs the U.S. Federal Drinking Water Standards, shows the ground water in Koh Lanta Yai contains an undesirable amount of fecal and total coliform, indicating pollution of the water sources from animal and human fecal matter (www.epa.gov/safewater/contaminants/index). The presence of nutrients such as ammonia and phosphorous above the drinking water standards also indicate contamination of water from both fertilizer and animal waste. (Table 4).

Table 4. Water quality monitoring

Testing Station	Parameter		US EPA Standard	
Station 1	Total Coliform	2400	Zero*	
	Fecal Coliform	2401	Zero*	
	Nutrients, mg/L			
	Nitrates	<0.5	10	
	Nitrites	4	1	
	Ammonia	34		
	Phosphorus	12		
	Total Suspended Solids (TSS), mg/L	12.6		
	Station 2	Total Coliform	3500	Zero*
		Fecal Coliform	2400	Zero*
Nutrients, mg/L				
Nitrates		<0.5	10	
Nitrites		<1	1	
Ammonia		<1		
Phosphorus		<1		
Total Suspended Solids (TSS), mg/L		25.8		

Source: District office Koh Lanta Noi

Saltwater Intrusion

The large dependence of the islands water resources on well water poses the threat of saltwater intrusion. Saltwater intrusion occurs when over-extraction of groundwater results in the drawing in of saltwater from the oceans into the freshwater aquifers.

Saltwater intrusion is a natural process that occurs in virtually all coastal aquifers. It consists of salty seawater flowing inland into freshwater aquifers. Seawater, which carries more solutes, has a higher density than freshwater. This higher density causes the pressure beneath a column of saltwater to be larger than that beneath a column of the same height of freshwater. If these columns were connected at the bottom, then the pressure difference triggers a flow from the saltwater column to the freshwater column.

Normally, the flow of saltwater inland is limited to coastal areas. However, this natural process

becomes an environmental problem when excessive pumping of fresh water from an aquifer reduces the water pressure and intensifies the effect, drawing seawater into new areas. Water quality testing in Koh Lanta Yai indicates presence of salinity in the freshwater aquifers. This salinity level will surely increase with further groundwater pumping, especially since groundwater recharge continues to be limited due to increase in impervious areas from development and forest clearance. This increase in salinity can have dire consequences for the islands agriculture, vegetation species, and water resources.

Solid Waste

Koh Lanta Yai has a pressing solid waste management problem which, if not addressed immediately, will be detrimental to not only to the public health and environmental quality, but the aesthetic quality of the island, a cornerstone of tourism. The solid waste problem has the potential to decrease the number of tourists and to lower their spending on the island. Currently, there is one solid waste dump situated in northern Koh Lanta Yai. It utterly fails to adequately meet the islands solid waste needs, especially during the high season.

The recent introduction of westernized practices on the island of Koh Lanta Yai has accelerated the rate of solid waste production and accumulation on the island. Only recently have islanders dealt with non-biodegradable solid waste. Traditionally, many things may have been made out of local resources that tended to be biodegradable, thus the habit of using something and throwing the remainder in the bushes where it would quickly rot or be eaten was understandable. Solid waste production increased with the importation of modern consumption practices, which in some cases are very different than the local habits. This entails the introduction of the "convenience goods" to the island. Plastic bags, paper plates, packaging, diapers etc. are imported and are typically used only once before disposal and do not biodegrade. Research about Pacific Small Island in developing states shows that over a nine year time-period, the amount of

solid waste generated per person has risen from 0.42Kg/capital/day to 0.66Kg/capital/day, a 57% increase they attribute mostly to "an increase in paper products and plastics", (Thaman).

This change affects not only rates of production but accumulation of wastes on the island. Thus, historical practices of how trash has been dealt with on the island may vary considerably with westernized notions of trash. Western, or westernized tourists, may not understand some of the trash patterns on the island and will be displeased by them while locals, without the experience of contemporary solid waste, may not be as bothered by the existence of trash seemingly strewn throughout the island nor understand its long term environmental impacts.

For the tourism industry, which is so clearly dependent on visitor's positive perceptions, this has the potential to create serious impact on tourism rates on Koh Lanta Yai. Existing solid waste problems that contribute to tourists negative perceptions on Koh Lanta Yai are:

- Overflowing roadside garbage bins that waits for days-on-end to be collected, or unsightly loose trash that creates an eyesore and communicates to tourists a lack of care.
- The current practice of burning household wastes contributes to aesthetic problems of burn piles and adds to the problem of air pollution on the island.
- The accumulation of loose trash in the island's water courses contributes to water pollution and beach litter. The trash flows out and then back in, collecting on the pristine beaches, themselves an important draw to the unique marine ecosystem of Koh Lanta Yai.

- Improper disposal of solid waste harms the flora and fauna of the island; two of the islands major tourist resources.

Types of Solid Waste

On the island of Koh Lanta Yai there are three basic types of solid wastes: compostable materials (organic wastes); recyclables (typically containers that can be re-used or their materials processed and re-used); and rubbish (things that must be disposed of and may or may not degrade). The basic problems arise not only in the amount of wastes produced but in the lack of differentiation in managing these wastes. On Koh Lanta Yai there is very little separation of these types of wastes because there is very little incentive to treat the wastes differently. Regardless of its composition, most of the waste on Koh Lanta Yai is treated like rubbish and thrown into the dump.

Morrison and Munro have analyzed the composition of domestic waste for Small Island developing States in the Pacific, which we can assume may be similar to what would be the composition of wastes on the island of Koh Lanta, (Table 5). If the components of solid waste were separated and treated according to their potential (i.e. recycling

Table 5. Typical composition of domestic solid waste for Pacific SIDS, (Morrison and Munro 1997).

Component Percentage by Weight (range)	
Garden waste (organic)	14-44
Food waste (organic)	2-4
Plastic (recyclable, rubbish)	4-16
Paper (recyclable)	2-13
Glass (recyclable)	2-17
Metals (recyclable)	8-17
Bone (rubbish)	<1
Rubber/leather (rubbish)	0-2
Bulk Density	100-350 kg/m3
Generation Rate	0.19-0.52 kg/cap/day

and composting) then very little would need end up in the dump. There is no cohesive system for recycling, composting, and disposal of solid wastes on Koh Lanta Yai so that they are disposed of accordingly.

In addition to these typical solid wastes, the construction of new developments creates a considerable amount of solid waste. Throughout the island, construction leaves behind great piles of waste, often potentially recyclable and re-useable. No standards for the management of construction site debris were evidently in force.

Solid Waste Management

The solid waste collected by local government ends up in a dump. (See discussion following). Collection is more consistent in high tourist season but irregular during the low season which adds to the unsightly and environmentally unfriendly accumulations of waste throughout the island. There is no system of solid waste pre-separation on the island. Recycling only occurs as a result of often variable for-profit ventures. These ventures encourage the unsanitary business of "after-dumped separation," where individuals pick through the garbage to separate valuables to sell to the middleman for profit. Thus, both recyclable and compostable wastes end up in the dump where they take up space, do not meet their re-usable and sustainable potential, and contribute to the unsanitary conditions.

The previous report disclosed that on average, people in Thailand produce .65Kg of waste per day. In comparison, tourists can produce between 3.23Kg and 10.10 Kg of waste per day (5-15 times the amount produced by local islanders). Thus, tourists produce a significantly higher amount of solid waste than locals, with an estimate of 10-12 metric tons of solid waste produced daily on the island of Koh Lanta during the high tourism season. This creates a situation on the island where the local islanders have to deal with the negative externality of the highly disproportional amount of waste produced by the tourism industry each year.

The extraordinary amount of waste produced by tourism is biggest problem of solid waste on Koh Lanta Yai. No laws, incentives, or system require the tourism industry to limit its amount of solid waste. In addition, the tourism industry is not paying fees proportional to the amount of waste disposed. For example, villagers pay 20 baht/month for the trash they produce, which we estimate to be about .9 baht per Kilo of waste. In comparison, the Pimali Resort pays 7500 baht/month for the amount of trash they produce. If we make a low estimation that Pimali has 100 guests a day, for 30 days producing the middle-range estimate of 6.67Kg of waste a day, that ends up being a low estimate of .6 baht per Kilo. (This is in a resort where the cheapest room is 13,500 baht per day.) By generous comparison, the tourism industry is paying an estimated 30% less for solid waste disposal than the local islanders. Considering the large burden solid waste creates for the island, tourist developments creating high amounts of waste should be paying significantly more than the low producers, especially given the highly detrimental effect.

Examples of sustainable solid waste management observed on Koh Lanta Yai are the direct recycling of water bottles for refilling at the water treatment plants, the use of waste as animal feed at the Narima Resort, recycling of all possible materials at the Narima Resort, and village-level composting. However, these practices need to be ubiquitous throughout the island.

Koh Lanta Yai needs a consistent solid waste management system, clearly defined responsibilities and tasks, and reliable mechanisms for waste separation and collection. Recycling is absolutely essential. Composting of organic waste holds significant potential as fertilizer for local and regional agricultural production and ornamental landscapes. Better guidelines need to be provided to deal with constructions wastes and debris. There must be greater education of locals and tourism interests need to made aware of their role and ability to help combat the solid waste problem on Koh Lanta Yai.

The Dump

The existing dump on Koh Lanta Yai is a disaster. The site is organized in an ad hoc way, with no system to prevent erosion and movement of solid waste (Figure 26). In addition, the location of the dump on a steep slope exacerbates these problems. The dump is built very near two creeks and at the top of two watersheds—it undoubtedly pollutes the adjacent streams, and the land and people of the lower watersheds. The unmanaged dump and lack of cohesive waste management system on the island gives little faith that measures were taken to prevent dump leachate from infiltrating the groundwater system. In addition, there are clear health risks for the individuals picking through the dump for recyclables. Given the lack of separation of rubbish from recyclables, reusable, and compostable materials the dump will expand rapidly under current levels of development. Increased development will undoubtedly lead to extension of the dump and magnify its problems.

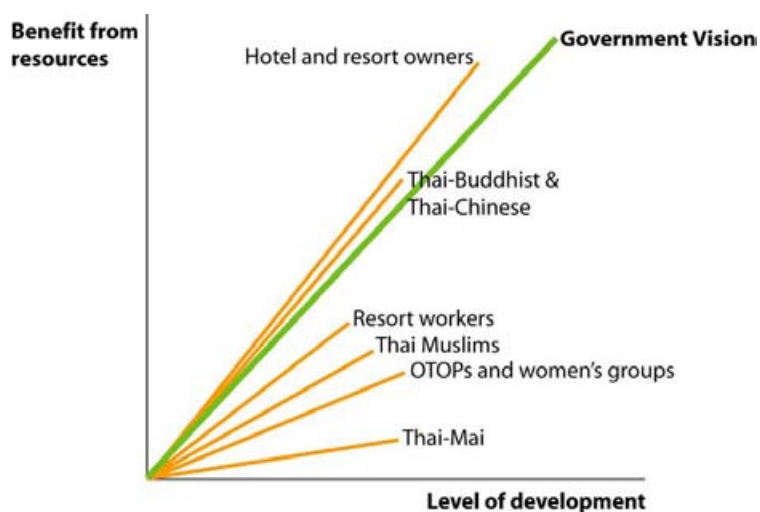
In creating an environmentally-safer sanitary landfill, (as opposed to a dump), certain factors are important to consider. These factors include: siting criteria, proper design, operating controls, groundwater monitoring and corrective action. The slope and soil characteristics play a significant role, as does the existence of nearby water bodies and floodplains. Because landfills result in creation of hazardous gases (methane) and leachate that could infiltrate into the aquifers and drinking water sources, proper care must be taken to provide adequate landfill liners. During landfill operation, access must be limited and daily soil covers must be applied to prevent vectors such as rats, rodents and birds from transporting waste.

To make sure that Koh Lanta Yai is meeting its sanitary landfill needs, an analysis of the existing dump must determine if it meets qualifications and standards. Given little doubt that the existing dump does not meet these qualifications, a survey of the island should determine a proper location for a new sanitary landfill site and estimate the solid waste needs of the island. Then the island should

Figure 26. The Dump.



Figure 27. Benefit from Resources.



invest in a properly designed landfill in conjunction with developing a new waste management system. Only by investing in the basic infrastructure of the sanitary landfill will the island be able to maintain the aesthetic qualities that draw tourists to the island.

Economic, Social, Cultural and Political

Interviews of more than 60 individual stakeholders on Koh Lanta Yai revealed the government-led tourism strategy has neither addressed the complex needs of Koh Lanta Yai communities nor strengthened them in the face of rapidly increasing international tourism. Local communities are open to tourism development, especially the benefit it may bring them, but are facing serious challenges in implementing the community-led sustainable tourism strategy that would bring them a just distribution of benefits.

Conceptual Framework: Communities' Responses to Development

The conceptual framework encapsulates findings in the field. Communities responded differently to the rapid increase in tourism, as shown by the orange lines in the diagram. Those better-off economically to begin with, such as the hotel and resort owners, were better-equipped to ride the wave of tourism and benefit from development policies as envisioned by the central, provincial,

and local government as represented by the green line. In contrast, resort workers and OTOP groups, received a smaller portion of tourism revenues – some of which leave the island altogether (Figure 27).

This socio-economic division coincides with religious affiliation. Capital owners are predominantly Thai-Buddhist with a Thai-Muslim minority, while resort workers and OTOP group members are Thai-Muslims. Two “outlier” communities were the rubber planters and the Thai-Mai. Some

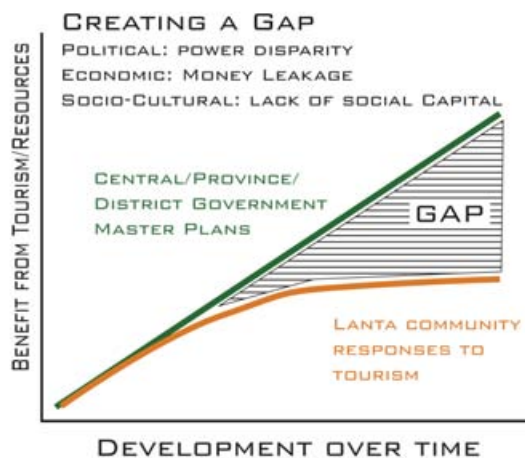
Thai-Muslims had capital invested in plantations, but many are owned by Thai-Buddhists who are not local residents. Political power has favored landowners over the landless, especially the highly nomadic Thai-Mai community. The Thai-Mai proved least equipped to benefit from tourism development. Addressing these divergent local capacities could prevent more serious injustices in the future brought about by cultural exploitation and dependence on tourism.

Analytical Framework: Government Vision vs. Community Trends

Government tourism plans envision tourism benefits will increase proportionately with the development of resources for tourism. The green line in the Figure 28 illustrates this trend. From the communities' perspective, the development of resources has not brought about many benefits. Borrowing the ecological term of carrying capacity, our listening process sheds light on the topping-out of the islands' socio-economic, cultural and political carrying capacity for tourism. As shown by the orange curve, this carrying capacity is topping-out well below the benefits envisioned by the government.

Further, this gap can be understood as the unequal access to power, profit leakages, and the lack of cultural/social capital. The challenge is to close this gap at the moment when the government is

Figure 28. Benefit from Tourism Resources.



resources. The influx of tourism and the vast differences in consumption patterns that result exacerbate these inequalities. Large resorts can set up water storage towers, fill up multiple swimming pools, and irrigate green lawns; while locals rely on a variety of water sources such as individual and village wells, and rainwater for their relatively meager consumption. Outside investors attracted by quick monetary gains offer seemingly large sums of money to villagers for their land, leaving the latter in a state of landlessness and disconnection from political powers (Figure 29).

opening up to a more participatory and sustainable tourism planning process. Because of this gap, the island's communities are facing serious challenges to implementing a community-led, sustainable tourism strategy.

Disconnection from formal political arena

During in-depth interviews, we systematically asked villagers to name the most influential leaders in their respective villages. We found community leadership in mosques and with village elders were more closely linked to communities' needs than were formal government such as the village headmen and TAO officers.

Elements of the gap

Challenges in collaboration and planning

At every level of governance, organizations are facing difficulties in collaborating to address development issues on the island. This results in uncoordinated public services (such as waste management and water provision) and in the allocation of resources on haphazard physical rather than community-building infrastructure.

Educational gaps

No secondary education system on the island exists. If the island's young people want a secondary education they must leave home and stay on the mainland. This places an enormous financial burden on local families. More importantly, it requires families to send youngsters away from home and out of parental supervision at an early age, something that for many families is culturally challenging, if not impossible. The lack of access to secondary education further disables the local

Resource insecurity

Natural resources such as water and land are unequally distributed among local communities that have unequal abilities to access these

Figure 29. Left, a Gleaming Row of Apartment Houses in Saladan Sits Across From This Row of Self-built Houses, pictured right.



community from taking advantage of the benefits of tourism. Some of the larger resorts such as Pimilai actually run schools for new employees to learn the the basics of English and the tourist business. This of course, ties the employees to a particular employer who reaps the majority of benefits from island tourism.

Cultural Resources

An analysis of Koh Lanta Yai tourism literature reveals that descriptions of the local cultures directed to tourists enthusiastically celebrate the island's tri-cultural harmony. Through our interactions with local residents of these cultures, 90% which are Muslim, we found that these are unique and distinct cultures, with different norms, beliefs, and practices (Figure 30). Their socio-cultural, economic, and political interactions are complex and cannot be summarized by a simple word like "harmony". In turn, these interactions manifest as inequalities of access to resources and disconnection from the political arena.

The system of town and village on Koh Lanta Yai carries with it, among other effects, identity-building functions. They are organized as a constellation of majority-Muslim villages ringing the island, with a commercial center on each side of the island. Key ecosystems also provide livelihood resources to local residents. Mangroves and coral reefs provide fresh seafood, while rubber plantations provide economic security. Access to these resources is contingent upon access to beaches and fishing zones out to the continental shelf. Access to land for

rubber plantation is diminishing due to pressure on owners to sell their land to tourism investors.

The influx of tourism is bringing local and foreign cultures closer to each other, causing occasional tension (Figure 31). In the case of the Thai-Mai community, their seafaring way of life has become a cultural attraction for tourism on Koh Lanta Yai. Their traditional boat festival has become the main item in the annual Lanta-Lanta Festival, drawing 3000 tourists. This, despite the fact the majority of local residents are not Thai-Mai, but Thai-Muslim. For a description of the Festival, see <http://www.laantalanta.com/festival&even.php>. Tourists are also drawn to Thai-Mai villages to see the their culture and way of life (Figure 32).

The local cultural fabric is likely to undergo rapid changes with increasing tourism. Tourism development will bring migrants from outside the island and diminish the importance of local residence in socio-economic life. Tourism will

Figure 30. Cultural Resource Distribution

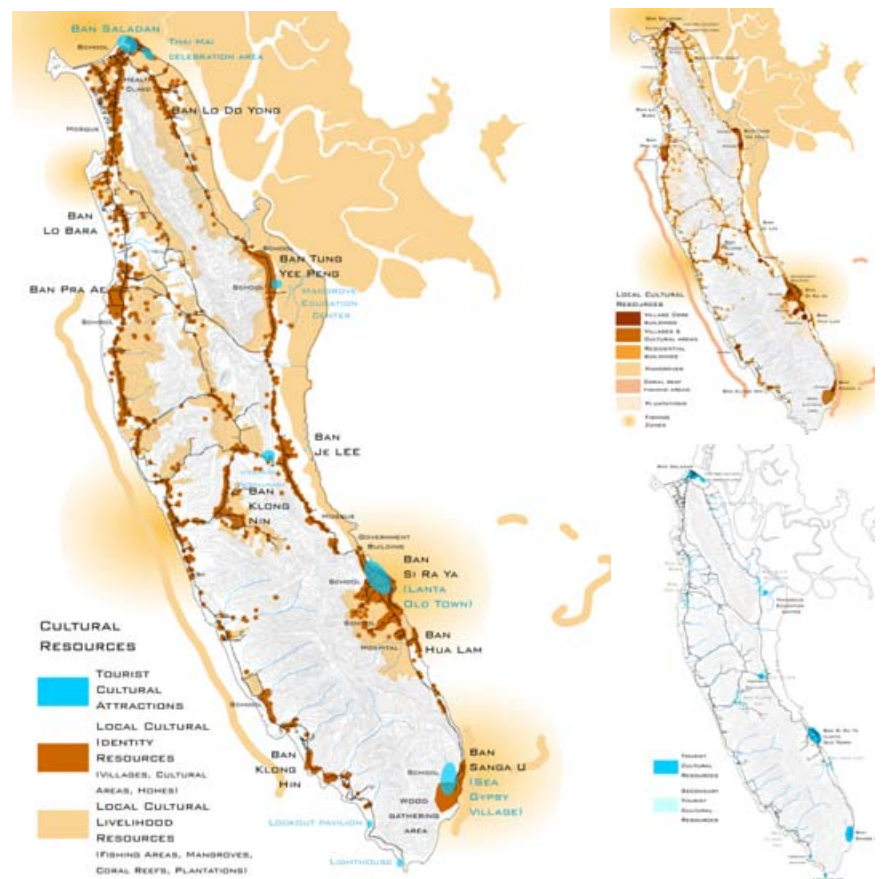


Figure 31. A Society in Transition: Images of Three Women on Koh Lanta Noi.



continue to increase the speed of socio-cultural and economic changes, potentially creating divisions along religious lines. If existing political capital continues to be eroded and disconnected from power structures, less-abled communities in Koh Lanta Yai face great risks of getting “short changed” in unjust situations and will benefit even less from the tourism industry.

Lanta Ban Rao – Facing the Future

The key to achieving a sustainable future for Koh Lanta Yai is to dedicate resources and time, to better understand the challenges facing the island, and to be willing to consider new alternatives to create a future that benefits the island's residents and landscape. Thus, at this pivotal moment, there are some immediate actions that need to be taken to

Figure 32. Paved Roads Bring Tourists into the Heart of Sang Kha Ou, a Predominantly Thai-Mai Village.





secure that, during the future development process, Koh Lanta Yai remains the tourist destination and home that makes it so special.

Immediate Recommendations

Moratorium on building new bridges

Before a bridge is considered as the last or only alternative, it is important to demand that the ferry operator meets the conditions of their contract, or the contract should be terminated and renegotiated. The island's access needs could be met by an adequate, modernized, and reliable ferry service. This would include: a differential ferry transit fee for locals and tourists; a faster, up-to-date ferry vehicle; and a high speed emergency boat system. Before making a decision regarding the bridge(s), the consequence of bridge development needs to be studied, including the effects of increased environmental impacts on the island. If a bridge is built, a comprehensive development plan should be created which includes projected changes in tourism numbers, tourism development and tourism quality.

Enforce existing laws to prevent destruction rainforests and mangroves

Existing federal laws preventing the destruction of the rainforests need to be enforced. The Thung Yee Pheng Eco Tourism Center (Mangrove Education Center) should be expanded to preserve upland rainforests as well as mangroves. In order to better educate tourists and locals about reasons and ways to preserve the mangroves and rainforests, (the locations shown in Figure 33), an educational

brochure should be developed and distributed. In addition, a conservation fund should be created in order to buy land for preservation. Funding could be secured by voluntary donations, conservation taxes, redirected tsunami funds and foundation grants.

Ensure tourism industry pays its fair share of infrastructure costs on the island.

Introduce a new, tiered fee schedule to charge for resource consumption, waste production, and transportation (Figure 34). Such a fee would be based on the amount of resource consumed or waste produced.

Figure 33. Location Map of Existing National Forest and Forest Preservation Zone.



Figure 34. Tiered Fee Schedule

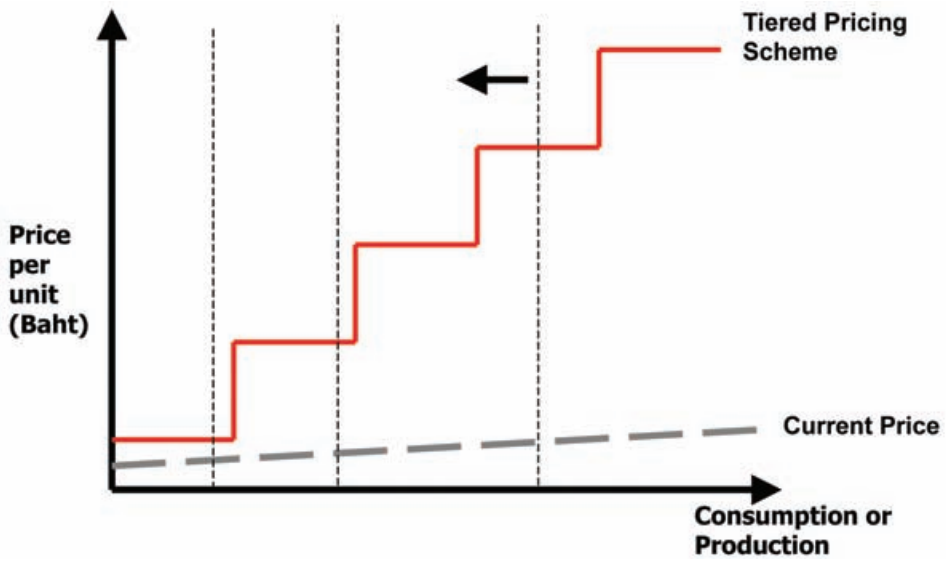
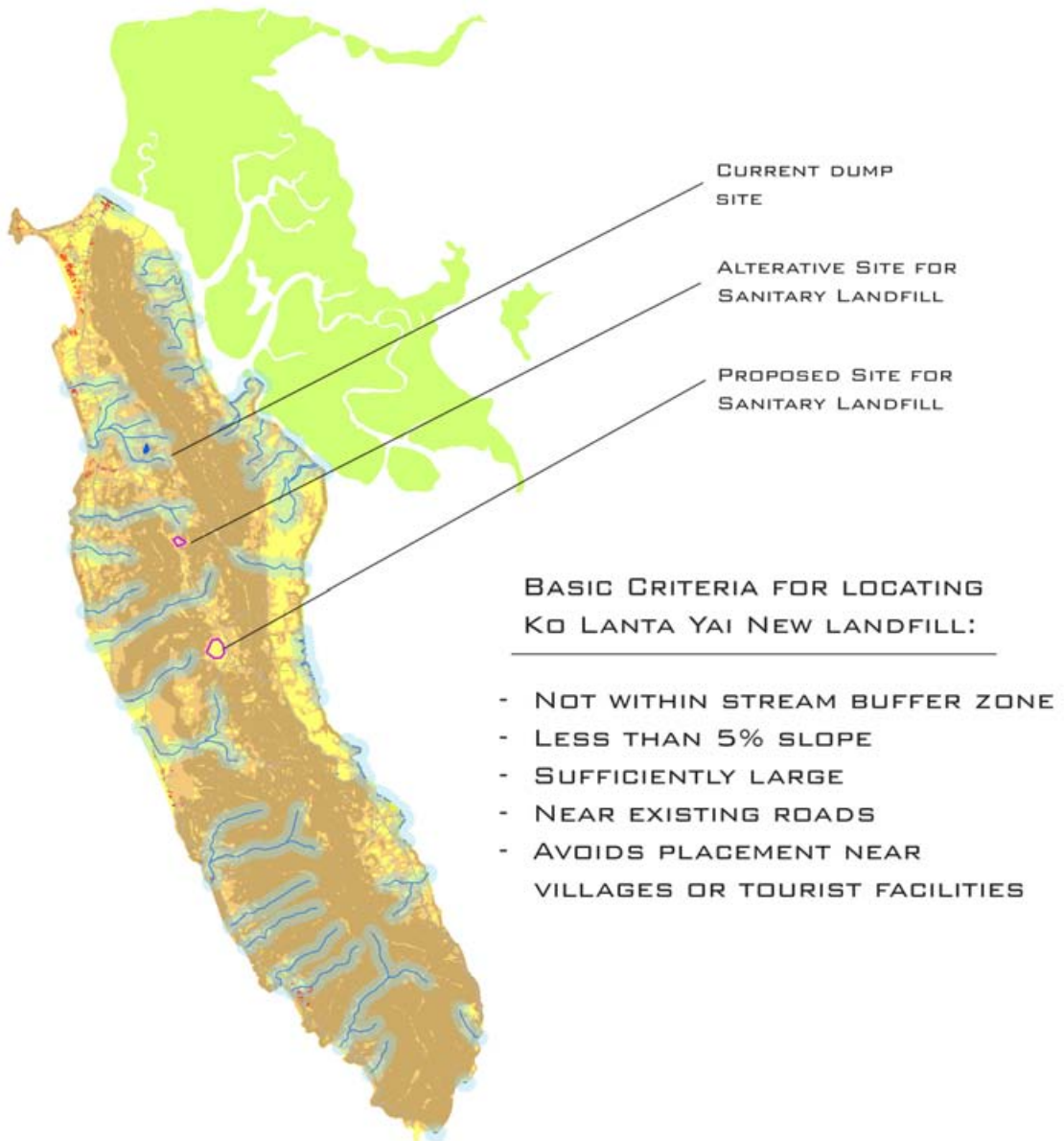


Figure 35. Criteria for Locating Land Fill



Build a sanitary landfill on the island and develop a comprehensive recycling program.

A new landfill should be located in an environmentally-appropriate area and have a design based upon international standards. A management strategy should be created that meets the solid waste requirement of existing and proposed growth on the island (Figure 35). Tourist and local education, through mechanisms such as brochures and classes on recycling, should be integral to the new management strategy to encourage the production of less waste.

Create a new forum; the Lanta Ban Rao to accomplish these immediate goals, and guide future development on the island.

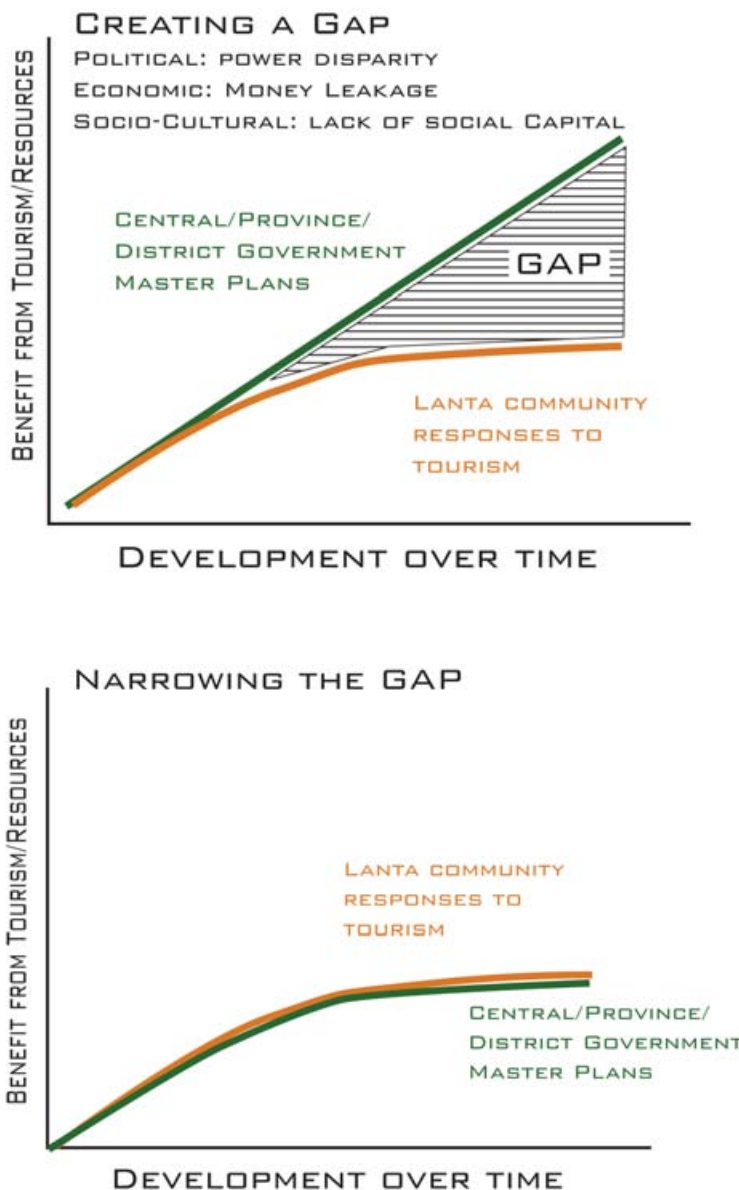
To be successful, the Lanta Ban Rao should ensure all interested groups on the island are represented with membership. In addition, the Lanta Ban Rao should have the power to focus government efforts and spending on issues important to the island's sustainable future (Figure 36).

Implementation: Lanta Ban Rao Forum

Today, a lack of inclusive, transparent governance on Koh Lanta Yai is directly contributing to ecological and social resource exploitation and degradation, which threatens Koh Lanta Yai's long-term viability in the global tourism market. In order to reverse this trend and move toward the model of sustainable development and resource management outlined in this report, all stakeholders in the island's future must enter into a coordinated and cooperative discussion that fosters communication between one another. In particular, three main voices must come together and assume responsibility for implementing a sustainable vision of Koh Lanta Yai's future: the voice of the people, the voice of the tourism industry, and the voice of local government.

Together, this tripartite Lanta Ban Rao Forum could develop and protect the unique identity of the island as a cherished and cared-for home. Within the community, a Lanta Ban Rao Council could provide a centralized island-wide setting for local residents to voice their ideas and concerns about their home. Within the tourism industry, a Lanta Yai Tourism Industry Association could provide both a similar voice to the island's tourism operators, and coordinate island infrastructure and environmental protection measures.

Figure 36. Creating and Narrowing a Gap



Finally, coordination between Lanta Yai's two tambons (districts) and one tessaban (municipality) would streamline the planning and regulation required for ensuring the environmental, social, and economic health of Koh Lanta Yai in the future.

The Lanta Ban Rao Council would be a self-sufficient community-led organization which unites and empowers the local people on Koh Lanta Yai. Membership would include local residents, the fishing community, rubber plantation workers, and local shop owners – in short, local citizens interested in providing a voice in shaping Lanta Yai's future. Tourists may participate in meetings and activities, but no government officials from the tambons or tessaban would hold seats in the Council. The initial step in creating the Council is to convene several island-wide community meetings, in which anyone is invited to participate and share their ideas and visions for Koh Lanta Yai. Regardless of the format, consensus should be reached early-on regarding a mission statement and a set of goals for the Lanta Ban Rao Council. Once established, the Council could offer programs and activities to teach locals and visitors about the unique environmental and cultural resources on the Lanta Yai. Examples could be: community beach-cleanup days, nature walks, classes about indigenous uses of plants, community-supported agriculture markets, and community composting programs to name a few. Funding could come from governmental community development grants, tourism tax revenue, and from visitor and NGO donations.

An association of all members of Koh Lanta Yai's tourism industry would greatly facilitate the implementation of the sustainable tourism recommendations enumerated in this report. Under the Lanta Yai Tourism Industry Association (LYTIA), all commercial tourism establishments – hotels, resorts, bungalows, restaurants, shops, and tour operators – should be required to register with the LYTIA. Membership could be mandated by local or regional government policy, with the goal of enforcing ecologically sound waste, water,

and resource management regulations. LYTIA could be an invaluable source of much-needed comprehensive baseline data about Koh Lanta Yai's tourism trends. The expanded membership of existing tourism industry groups such as the Koh Lanta Yai Business Circle, could include all resorts, bungalows, and other tourist establishments on the island, forming the basis of the group. Eventually, the LYTIA could be linked with a local branch of the Tourism Authority of Thailand (TAT), to allocate funding and resources to the LYTIA for data collection and processing, and for education and incentive programs.

Better coordination between existing local government entities is essential to the implementation of sustainable development and resource management on Koh Lanta Yai. The island needs a formal mechanism for collaboration and communication between Tambon Saladan, Tambon Koh Lanta Yai, and the Tessaban Koh Lanta Yai. Coordinated planning among these three local government entities will be critical to establish and enforce island-wide zoning plans, regulations, and policies. Local government authorities need to coordinate plans for island-wide issues such as waste disposal and management, water quality and supply, recycling and composting, infrastructure provisioning, and tourism revenues. Their plans should complement and facilitate one another, not duplicate or conflict with one another.

Finally, and most critically, formal and mandatory two-way channels of communication must be established between these three institutions: the Lanta Ban Rao Council, the Lanta Yai Tourism Industry Association, and a unified local government. As a mechanism to facilitate cooperation and collaborative planning between these three governance structures on Lanta Yai, establishing the Lanta Ban Rao Forum will benefit the island in three important ways: policy transparency, and checks and balances; streamlined planning efforts through collaboration; and a strengthened island identity. With all parties in conversation, consensus

about the island's future development patterns could lead to a shared vision of Koh Lanta Yai which truly reflects the needs and desires of the island's own community.

- Transportation: west coast island bike path, bus system with differential fees
- Market Koh Lanta Yai as an exemplary sustainable tourism destination

Goals of Lanta Ban Rao

- Support implementation of immediate recommendations
- Establish Lanta Ban Rao Forum
- Sanitary landfill
- Moratorium on bridges
- Preserve existing forests
- Tiered infrastructure fees
- Implement programs for long term sustainable development
- Direct development – zoning, construction practices, building standards, best management practices incentives, Green Leaf certification, community-based development review board
- Develop a comprehensive water resources plan: survey of existing resources, plan for long term water resources needs including recycling, tiered water consumption fees
- Education system: new high school, local and tourist environmental education, environmental field research station
- Reform hotel and tourist tax system to provide funds for land acquisition for environmental protection, restoration projects, environmental monitoring, public transportation

Directed Development and Cluster Tourism

Koh Lanta Yai's ability to attract tourists is heavily dependent on the health and quality of its beaches, water supply, mountainous and forested landscapes, as well as the vitality of its coral reef. It is critical to safeguard these resources from impacts brought by the tourism development process. Establishing controls and placing some restrictions on development is the only sure way to safeguard the island's resources for the future. A plan towards this goal is to establish a cluster strategy that directs tourism-related development to certain designated places on Koh Lanta Yai. This kind of development includes hotels, bungalow resorts, commercial services used by tourists, and related infrastructure. The clusters are located around existing tourism hubs and promote denser development within their boundaries. Village areas are to be maintained and protected for use by local people to the greatest extent possible. Eco-restoration and protection zones are designated in the areas between clusters and villages with priority to coastal, riparian, and rainforest areas. The west coast clusters are connected by an island bike path that functions to relieve traffic along the main roadways and is itself a significant tourist attraction.

Descriptions of Proposed Tourism Clusters

The clusters strive to address the current and foreseen tourism demand on Koh Lanta Yai. Clusters each have attributes and characteristics that serve to facilitate a certain variety of tourism traffic that is compatible with the island's culture.

Advantages of creating clusters

This type of infill strategy has a number of advantages. First, clusters create a physical boundary to separate zones of urban development

and non-urban landscapes, resulting in an improved view shed over time as the forested and vegetated areas are allowed to fill in or remain between development areas. Second, as a practical issue, the cluster strategy will make infrastructure and services delivery more efficient. For example, if hotels and resorts begin to locate closer together and design their grounds to feature shared access and circulation areas, solid waste collection will be less costly and time consuming. Public transportation needs may also be more easily addressed. Later, as the concentration of tourism into clusters becomes apparent, there will be a justification to extend centralized services such as sewer and water. Extension of centralized services over time lessens acquisition costs and the burden on local users. Likewise, it raises the standard of accommodation and level of amenities the island can offer tourists, making it more competitive both domestically and internationally. Third, this strategy will facilitate locally-driven economic development as the concentration of tourism within the boundaries of the cluster begins to create a demand for goods, services, restaurants, souvenirs, and excursions. Fourth, the cluster strategy also provides an opportunity to consolidate marketing efforts and to attract environmentally conscious tourists. These kinds of tourists can have a greater potential for longer stays and higher spending than other kinds of tourists. Fifth, the cluster strategy would work symbiotically with a west coast bike path. The bike path would be a considerable tourist attraction, provide a means of tourists moving from one cluster to the other without vehicular traffic on the main west coast road, generate additional revenue by tourist business such as bicycle rentals, and serve locals as well. Last, and most importantly, the cluster strategy establishes an island-wide priority to prevent further decimation its watersheds, coastlines, rain forest, reef and mangrove areas (Figures 37 and 38). Over time, with more highly controlled development, these areas stand to see measurable improvements in their impacts on the local environment and tourism revenue generation.

Family and entertainment cluster

Located immediately south of Saladan Village, the family and entertainment tourism cluster is the largest of the Koh Lanta Yai clusters. This cluster is situated among existing hotels, resorts, commercial services that have always played a central role in the island's tourism economy. This area will be noted for its family-friendly atmosphere, beach community, and ease of access from the Krabi mainland and to excursion providers. The justification for the family and entertainment cluster is that it takes advantage of proximity to the pier, beaches, and existing hotels and resorts.

Muslim-oriented tourism cluster

Located south of the family and entertainment cluster adjacent to an Islamic community, the Muslim-oriented tourism cluster aims to target Muslim tourists. This cluster will abstain from serving alcohol in its tourism establishments. Conservative dress guidelines make beaches a place where Muslim tourists can visit without concern. The services of the adjacent community's mosque will be available for tourists as needed (or another one constructed solely for Muslim tourists) and there should be halal food-serving restaurants and vendors widely available. Overall, this tourism cluster is notable for its quiet, family-oriented atmosphere. The growth of Muslim tourists from places such as Indonesia and Malaysia has created demand for destinations for these kinds of travelers that can satisfy specific dietary, religious, and cultural needs.

Upscale tourism/centralized commercial cluster

Located at the junction of the cross-island road, the centralized commercial cluster aims to provide a variety of upscale services and shopping opportunities for visitors staying on the southern half of the island. A diversification of products and services (health tourism, spa treatments, yoga centers, etc.) paired with its location near some of the Koh Lanta Yai's most exclusive resorts will encourage tourists to explore beyond the reaches of their hotel grounds. The creation of this cluster will

Figure 37. Location of Tourism Clusters Relative to Ecological Preservation & Restoration Areas.

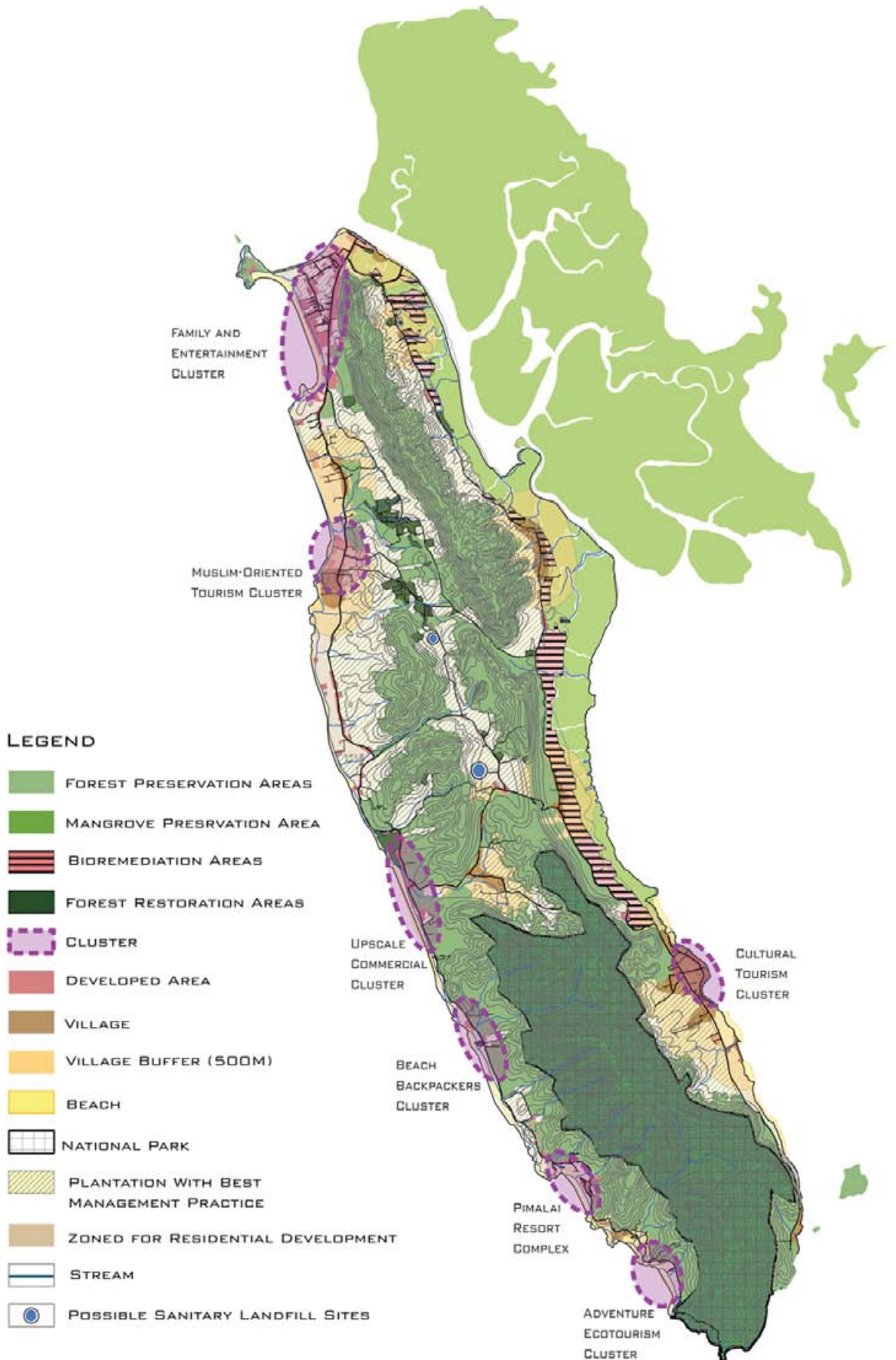


Figure 38. Watershed Health Classification Map with Cluster Proposal



act as an employment center for people living on Koh Lanta Yai. The placement of a new commercial hub on the island may also help reduce vehicle traffic along the west coast to Saladan Village. Improving the streetscape and establishing a set of design guidelines for tourism-serving enterprises will help reinforce the identity of this cluster.

Beach Backpacker Cluster

Today, young adult tourists visiting Koh Lanta Yai are spatially dispersed across the island due to the lack of a centralized location with budget accommodations and services they generally seek. The result of this dynamic is inexpensive resorts, excursion services and drinking establishments locate themselves in an unplanned manner. This unorganized placement presents a conflict for the conservative Muslim communities nearby and family tourists. The establishment of a beach backpacker cluster responds to the need to provide

budget-minded accommodations and basic amenities for young adult travelers in a centralized location. This cluster will be a place where young travelers can meet and interface with people of similar age and status in restaurants, bars and excursion points. Core activities will be shopping, the market, informal dining, sightseeing and beach activities. It may be important for this cluster to provide adequate signage and enforcement of policies that will promote the cleanliness of the streets and beach areas.

Pimalai Resort Complex

Actions should be taken to prevent further sprawl of the Pimalai Resort on the southern coast of Koh Lanta Yai. Begun as a beachside luxury resort, in recent years Pimalai has aggressively expanded and now has an unmistakable and garish presence on the slopes above the beach. The style and scale of the complex drastically conflicts with the local architectural vernacular. Environmental impacts of this type of resort development include erosion and sediment displacement, overuse of ground water supplies, clear cutting and habitat destruction. Public beach access is hindered for other tourists visiting Koh Lanta Yai. The purpose of establishing a cluster location at Pimalai is to enable the island to enact restrictions and guidelines which require the resort (and others like it) to adopt sustainable operating and management practices. The goal is not only to limit the growth of this type of resort, but to institute a standard for how they use resources, operate their facility, and dispose of their wastes. The guidelines will also place a priority on redesigning and improving the visibility of the public beach access near the Pimalai complex.

Adventure Ecotourism Cluster

Adventure and activity-seeking tourists will be well-served with the establishment of a cluster showcasing Koh Lanta Yai's ecotourism offerings. Located near the entrance to the National Park, the cluster will have remarkable access to a wide variety of activities: bird and animal watching, beach going, hiking, snorkeling, diving, elephant trekking and boating. The cluster is aimed at attracting socially-

conscious tourists that appreciate the seclusion the location offers and the proximity to the island's most treasured natural landscapes. Existing hillside resorts provide simple, rustic accommodations for travelers with a variety of services for comfort and convenience. Immediate beach access is not available at this location, but quality beaches and boat launches near the Pimalai Resort Complex cluster are only a few kilometers away.

Cultural Tourism Cluster

The Old Town center on the southeast coast of Koh Lanta Yai is the location of the final proposed cluster which will be starting point for various cultural tourism activities. The picturesque setting of the Old Lanta Town provides the backdrop for where tourists assemble to meet providers of cultural excursion activities. Here, visitors begin to learn the history of the island from community representatives and field guides. The cluster will be a transit hub for people interested in traveling into the field to see the island's mangrove restoration area, sea gypsy villages, and its operating rubber plantations. At this location and in adjacent settlements, there is the option of offering home stays for tourists looking for a deeper cultural experience on Koh Lanta Yai. Old Lanta Town can benefit from tourism through coordinated efforts of merchants and tour providers to improve products and services tourists generally seek (pharmacy, banking, souvenirs, dining) and to improve the on-the-street experience for visitors. Tourists also benefit from the meaningful exchanges they have participating in the variety of locally-provided touring activities.

Pra Ae Beach and the Muslim-Oriented Tourism Cluster: An Example of Cluster Development

The example of Pra Ae Beach, the Muslim oriented tourism cluster, suggest a number of features and improvements that might be found in Koh Lanta Yai's cluster locations. First, the most critical feature of the cluster is the presence of centralized infrastructure that provides efficient access to safe, clean water and a centralized wastewater and sewage treatment. The challenge of efficiently

collecting recyclable materials on the island is aided by providing adequate waste recycling collection stations – such as bins for beer bottles – that are regularly serviced and emptied by the TAO or municipal authority, keeping the cluster clean and maintained. The lush, forested coastline and buffers around urban streams and riparian areas protect, and are integral to, the visual quality of the development. These urban buffer zones are regulated by development setbacks for hotels and resorts that would otherwise infiltrate the desirable coastal areas. Pedestrians and locals have open access to the coast with the improvement of an access corridor that extends directly from the center of the cluster to the beach, through resort property if needed, to provide the public unhindered access to coastal open space. Features of the cluster that make it more livable for locals include a community medical clinic, a community center, schools and mosque located near residential areas, sidewalks, street trees and new main street development serving both tourists and locals. Other features that make it attractive to tourists include a pedestrian promenade to the beach, sidewalks and crosswalks that improve safety, a coastal bike path, a nature trail network, and a public transportation network.

Criteria for Future Development – The Narima Example

As previously discussed, the Narima Resort offers a case study for ecologically-conscious resort development on Koh Lanta Yai. The resort owners adhere and promote what they call their "eco-philosophy", which serves to minimize a range of impacts the resort has on the surrounding environment. It is a model that other existing and future resort developers can look to for ideas about sustainable building, operating, and management practices. Located on the southwestern coast, Narima's 30-odd bungalows are well hidden within the forest canopy that has been allowed to remain and grow around it. Their strategies include utilization of technologies and practices that save water and energy, and minimization of solid and sanitary waste production. The forested coastline

is a main feature of its naturalistic design concept (Figure 39). The resort is designed around natural features such as trees, slope, and beach rocks minimizing disruptive grading and consequent erosion. Preservation of the overhead canopy shades the bungalow structures minimizing heat gain. All waste from the resort is separated and recycled – the owners educate their employees in recycling practices. The bungalow units save energy in a variety of ways. Individual units do not have televisions. Regionally derived construction materials and forms help keep the rooms ventilated and dry without air conditioning. The bathroom is isolated from the bedroom, open to the outside, and cannot be air-conditioned. The water for the resort is drawn from surface water upstream – no depletion of the aquifer takes place. Sewage is treated on site (even though regulations do not require it) and then the treated water irrigates

the grounds, returning the clean water to the watershed's hydrologic cycle, minimizing watershed loss.

Next steps

The roadmap for implementation of the cluster strategy is contingent on gaining buy-in from several critical groups on the island. The process will require stakeholders to be flexible and willing to take on new roles and responsibilities. The stakeholder groups identified in previous portions of this report should find an acceptable way to collaborate together about how the cluster strategy might be best implemented.

To start the process, we suggest that stakeholder groups on Koh Lanta Yai collectively decide on two cluster options to test as pilot programs over a

Figure 39. Illustration of Narima development



period of three to five years. Responsibility for all tasks needed to carry out the cluster concept shall be assigned to stakeholder groups. The potential for the Lanta Ban Rao forum to play a critical role in this process is clear.

A balance between the interests of the local governing authority and the needs of the community to manage tourism on the island must be met. The community groups' ability to coordinate and follow a clear implementation plan can demonstrate to the governing authority that local people are capable and willing to play more active roles in determining the future of their island. Government willingness to enforce new guidelines and restrictions, to request and allocate funds for centralized services, and to cede some authority and responsibility to local groups, will all be necessary.

The inability of the governing authority to comprehensively address the multitude of dire problems on the island also suggests that a new dynamic is necessary between Bangkok and the Provincial and Local governing authorities to enable more local control of development decisions, funds, and projects on the island. The situation on Koh Lanta Yai is unlikely to exist within a vacuum. Other places in Thailand where tourism plays a major role in shaping the local livelihood stand to benefit from learning about alternatives to top-down development that is the standard practice. Given its political and social history, Thailand is not the easiest place to suggest a plan such as we have outlined. However, the mission of our Universities that emphasize research, teaching, and public service compels us to provide this unhindered opinion regarding the future of tourism on Koh Lanta Yai.

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